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Yaphe et al.

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(54) **LINEAR FIXTURE SUSPENSION SYSTEM**

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(30) **Foreign Application Priority Data**

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(52) **U.S. Cl.** **362/382**; 362/225; 362/260
(58) **Field of Search** 362/219, 249, 362/404, 225, 260, 382; 248/343

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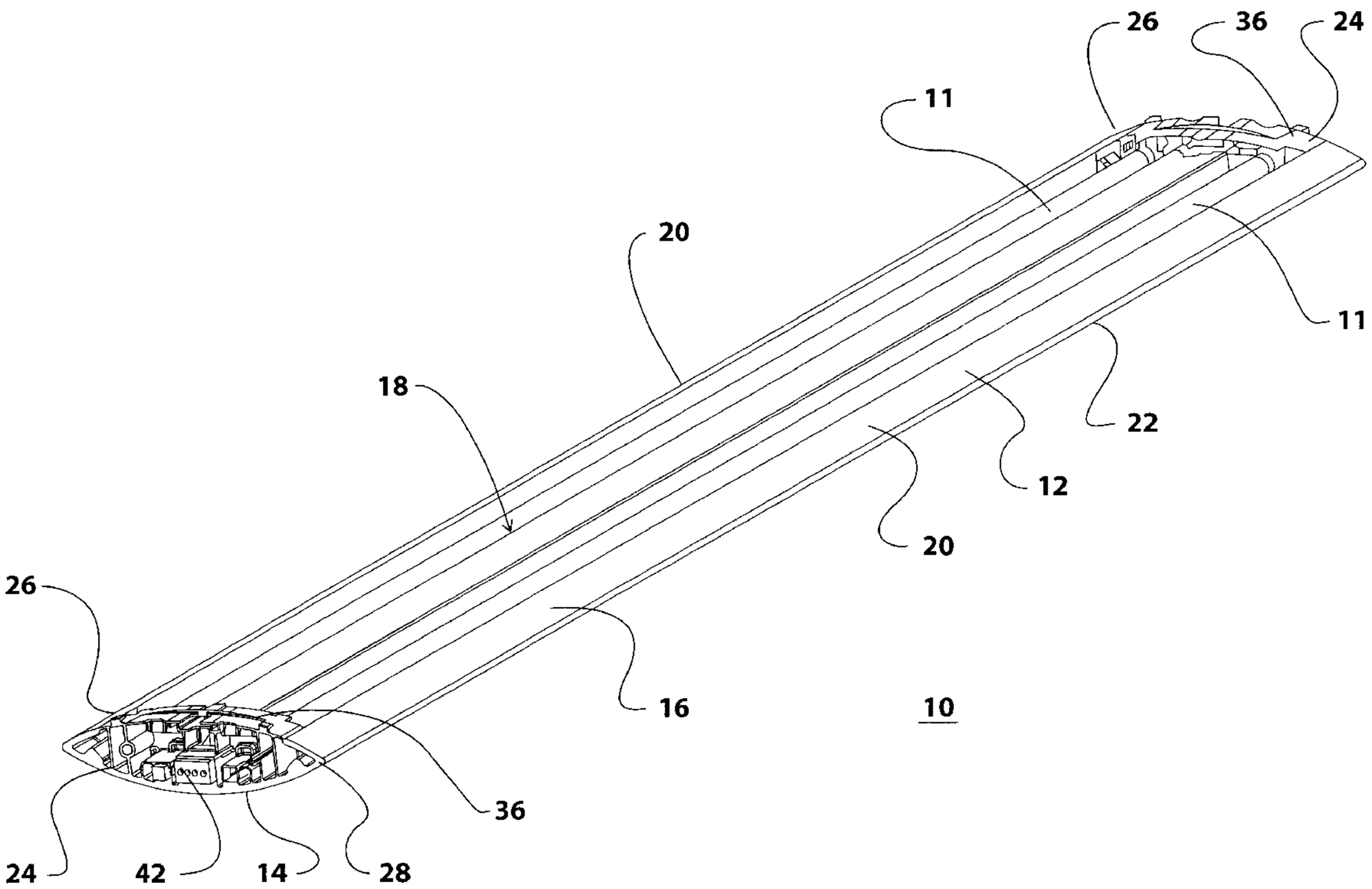
(57) **ABSTRACT**

Disclosed is a suspension system for suspending linear fixtures from an overhead structure which permits temporary suspension of adjacent fixtures prior to final locking connection of the fixtures. The system has a hanger member comprising a bridge member, an elongated alignment member, and at least one clamping member supported from the bridge member for relative vertical movement therewith. Additionally, the clamping member has two spaced apart wings each adapted to be inserted loosely adjacent a corresponding one of a pair of adjacent clamping surfaces when tongue insert positions are inserted into alignment receiving slots. The clamping member may be moved vertically to bring the wing members into clamping engagement with the clamping surfaces and move end portions of the linear fixtures toward each other into locking engagement.

26 Claims, 19 Drawing Sheets



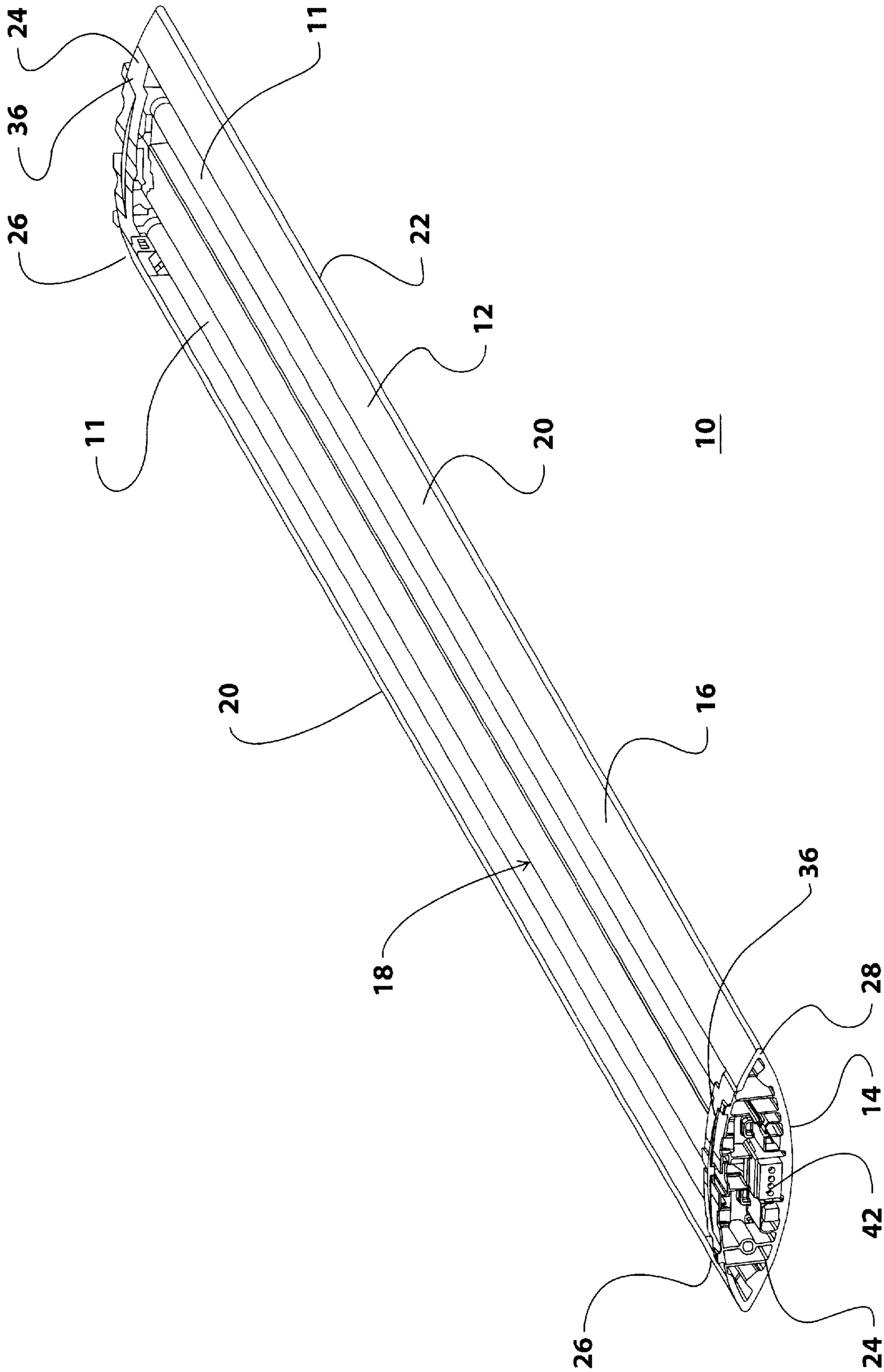


FIGURE 1

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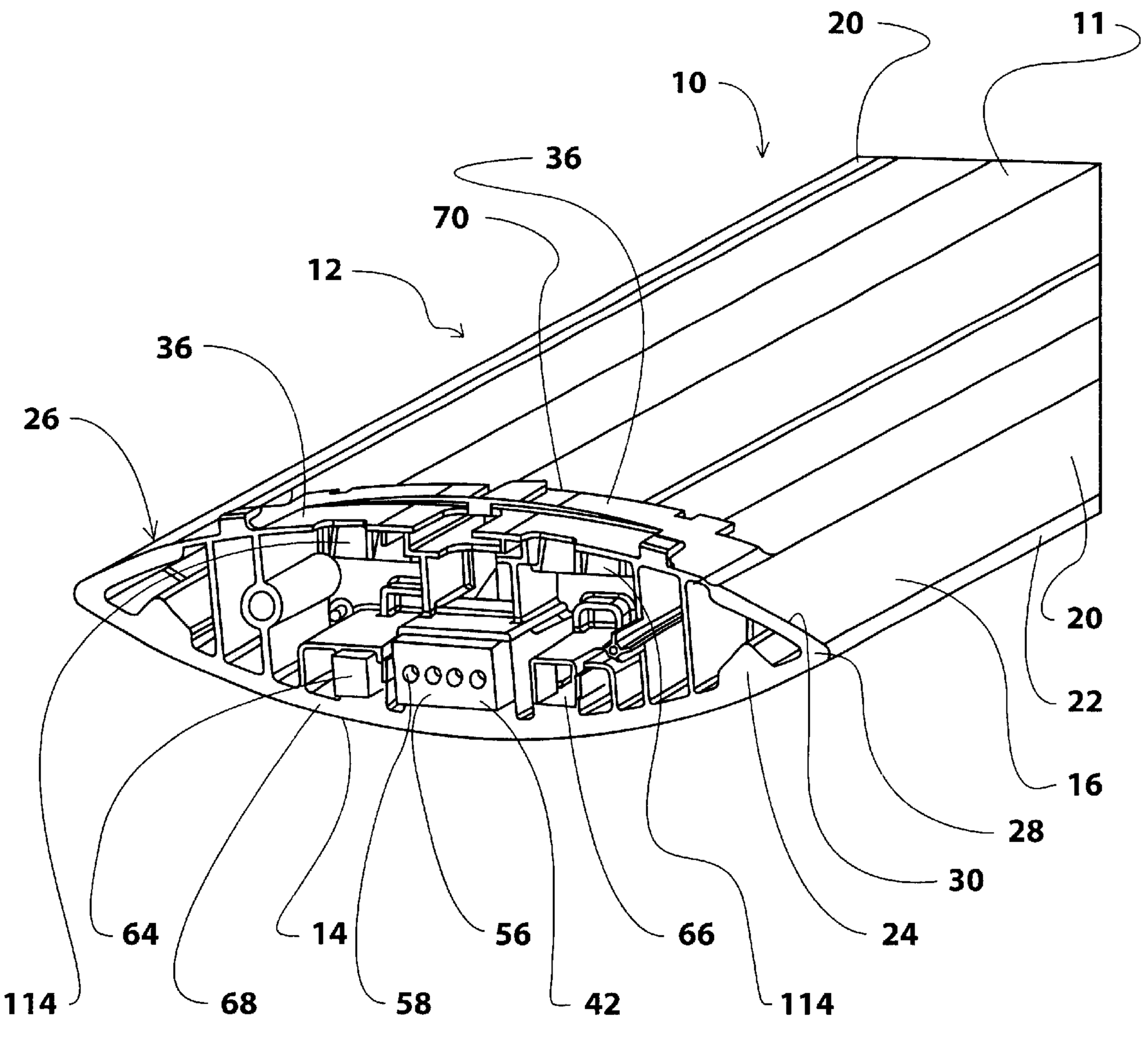

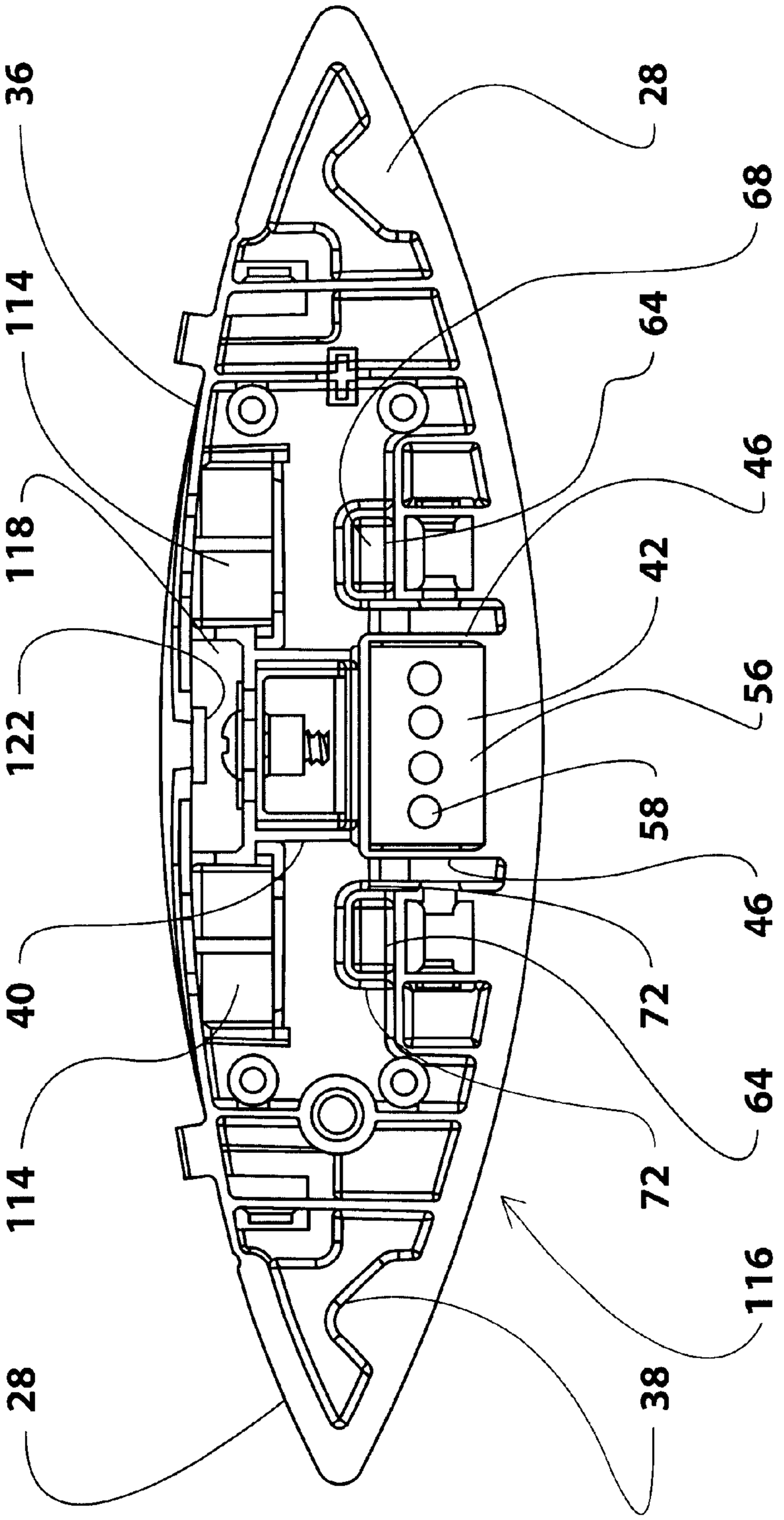

FIGURE 3

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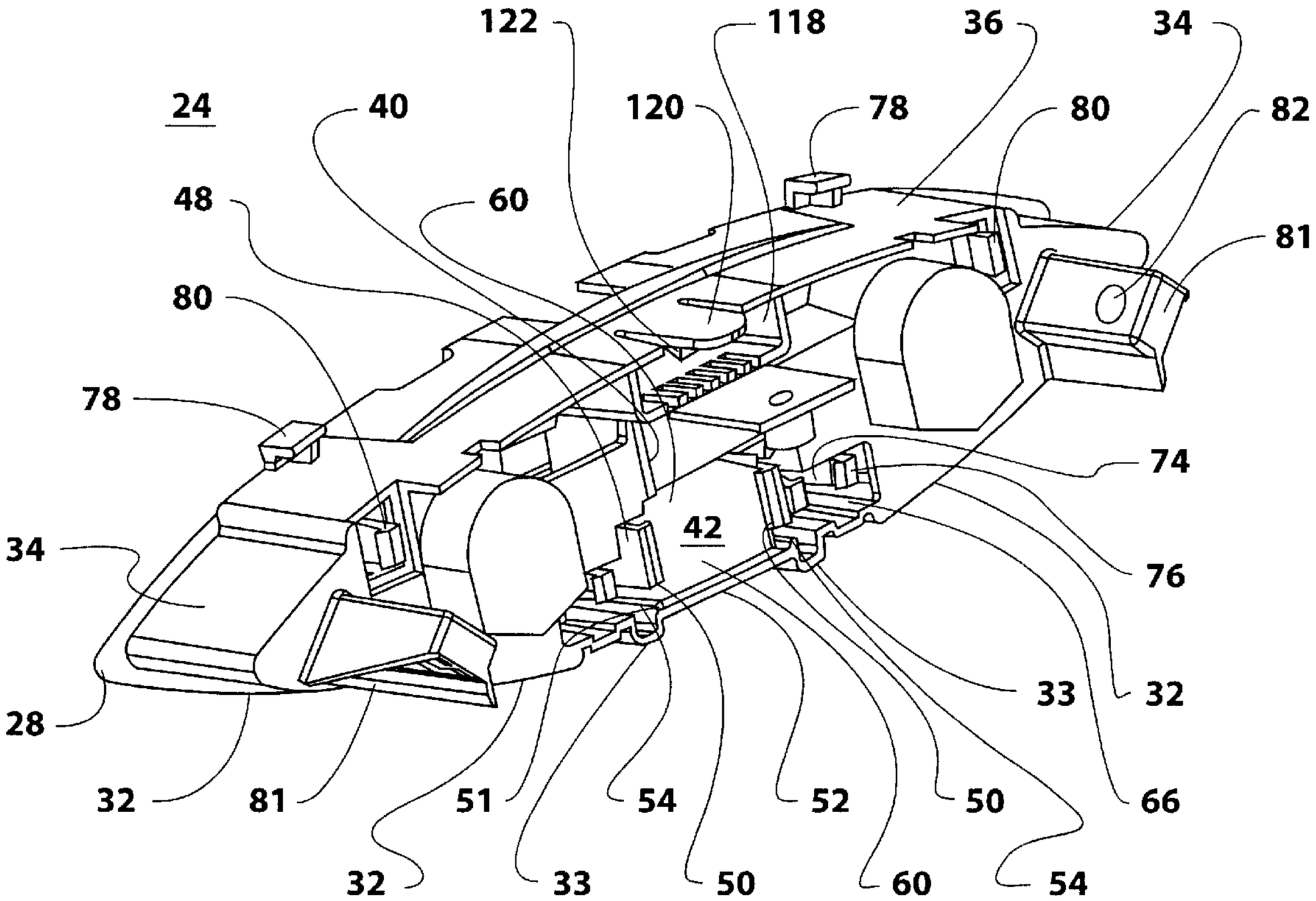

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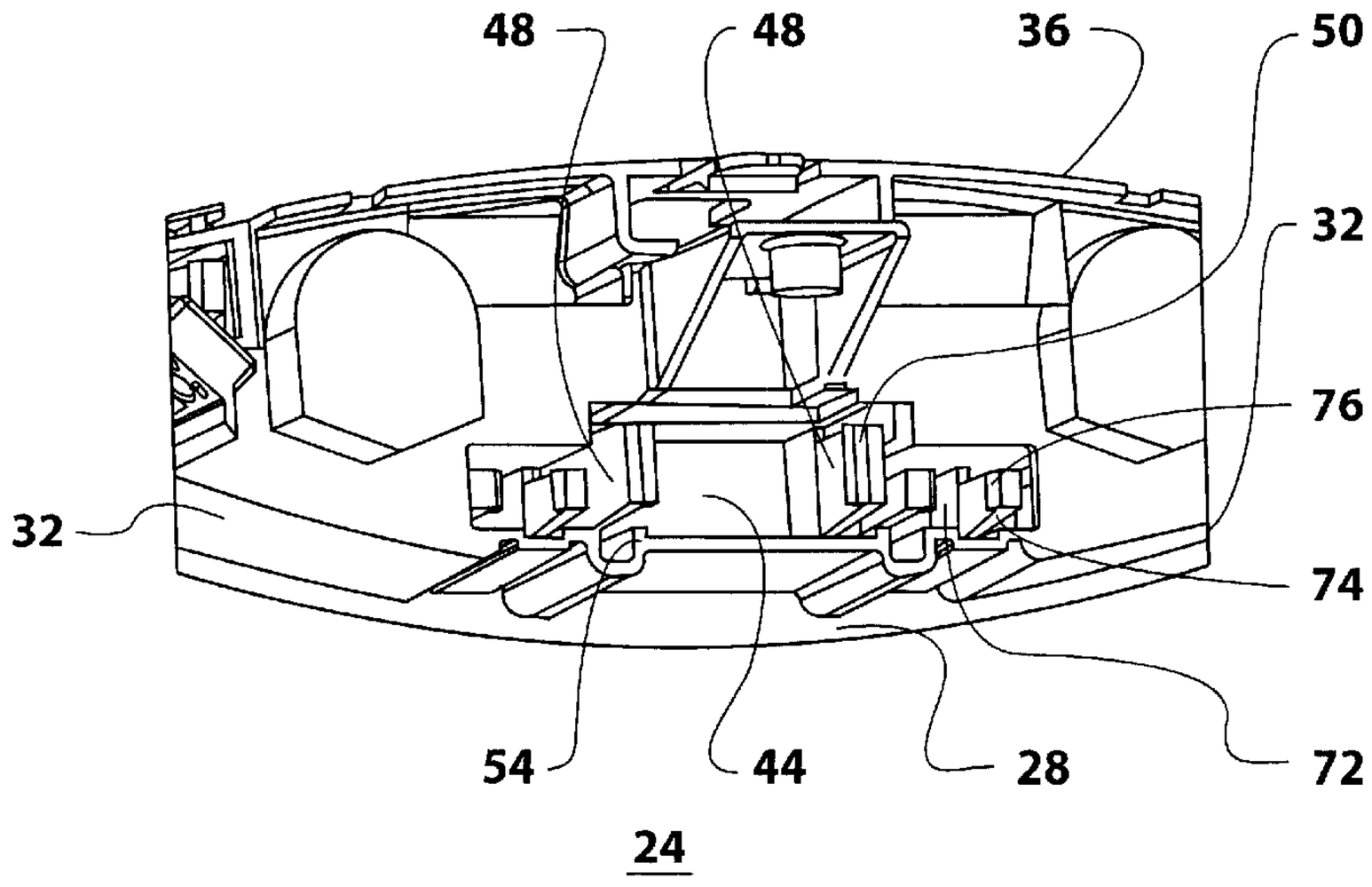

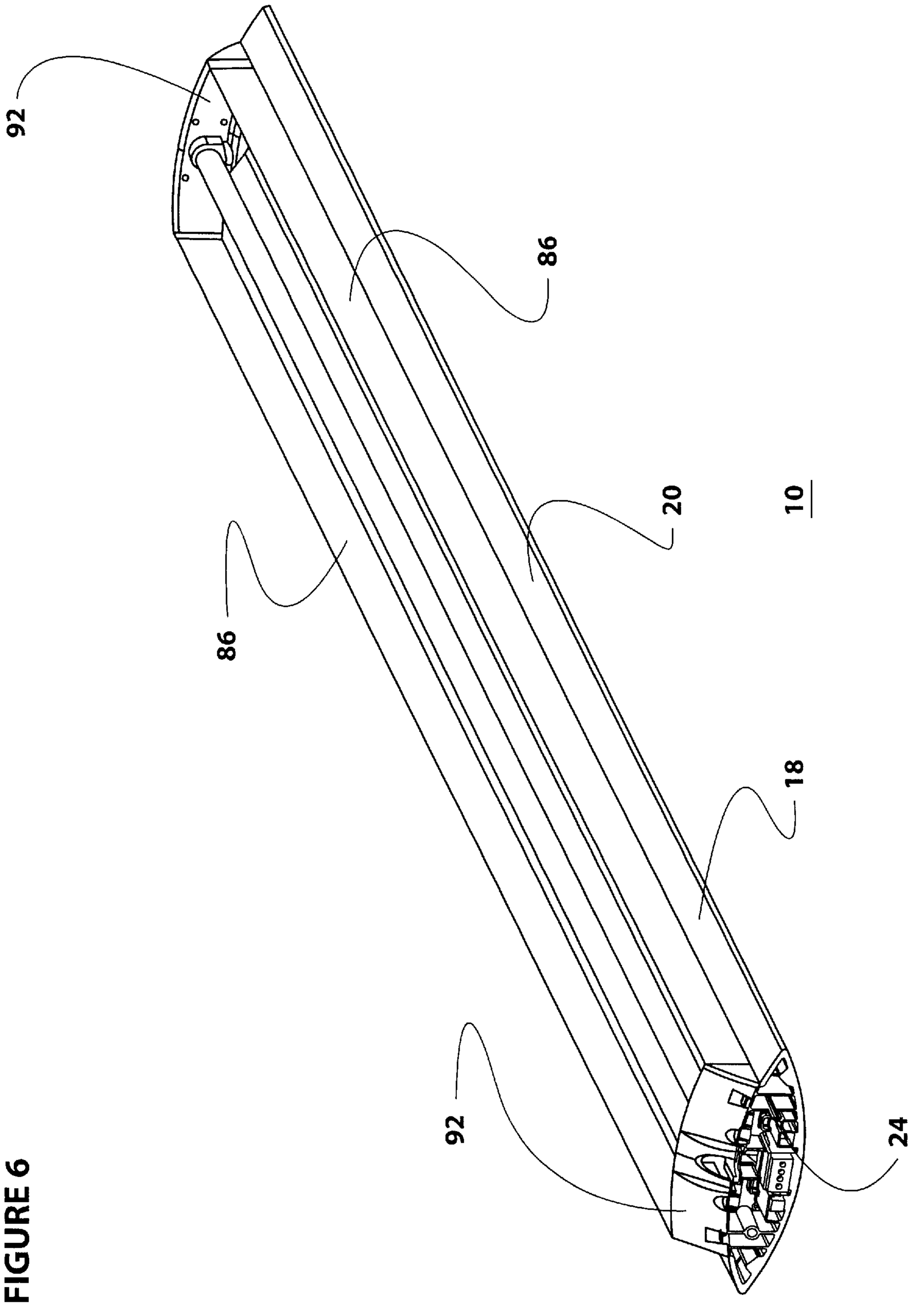

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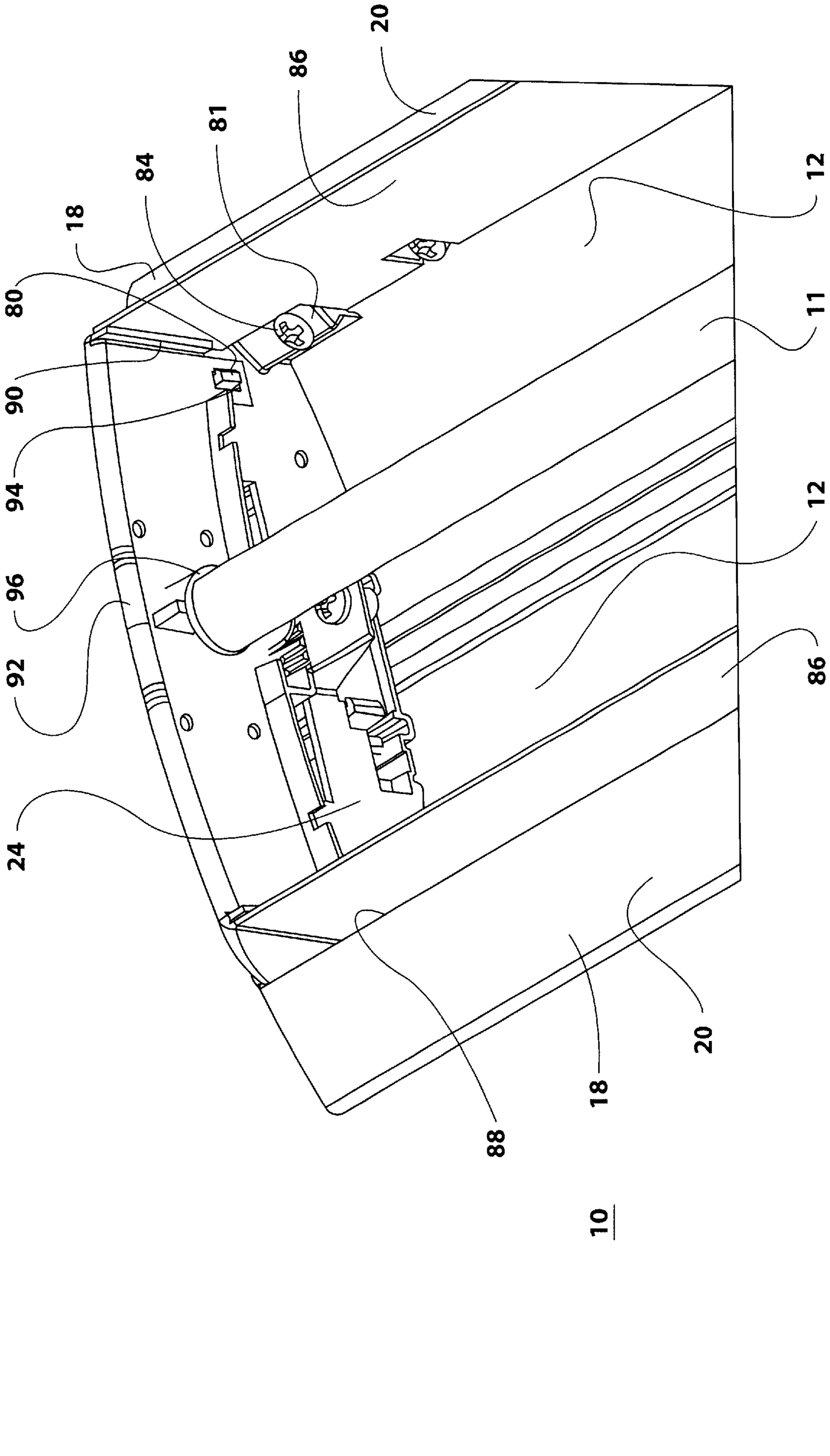

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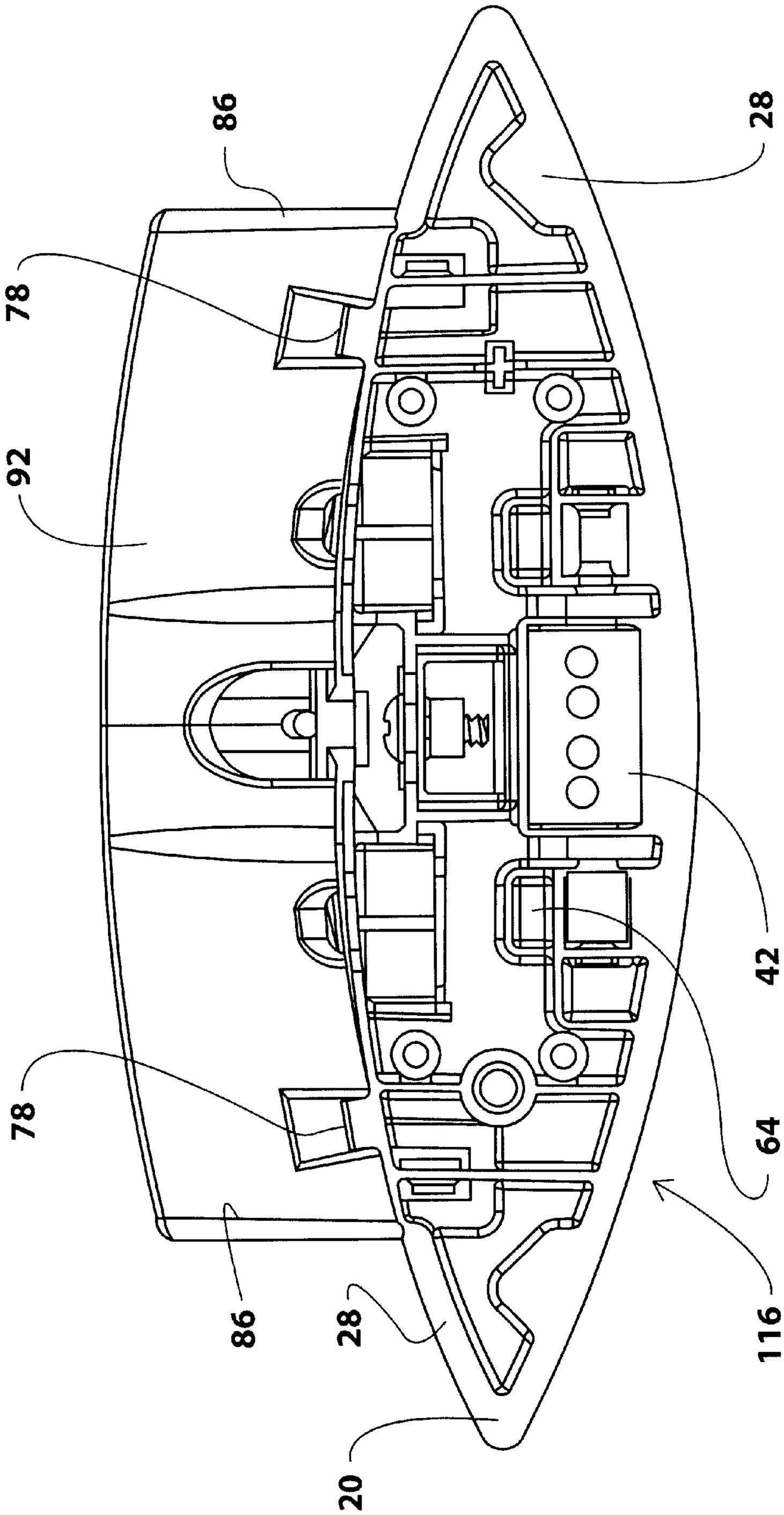

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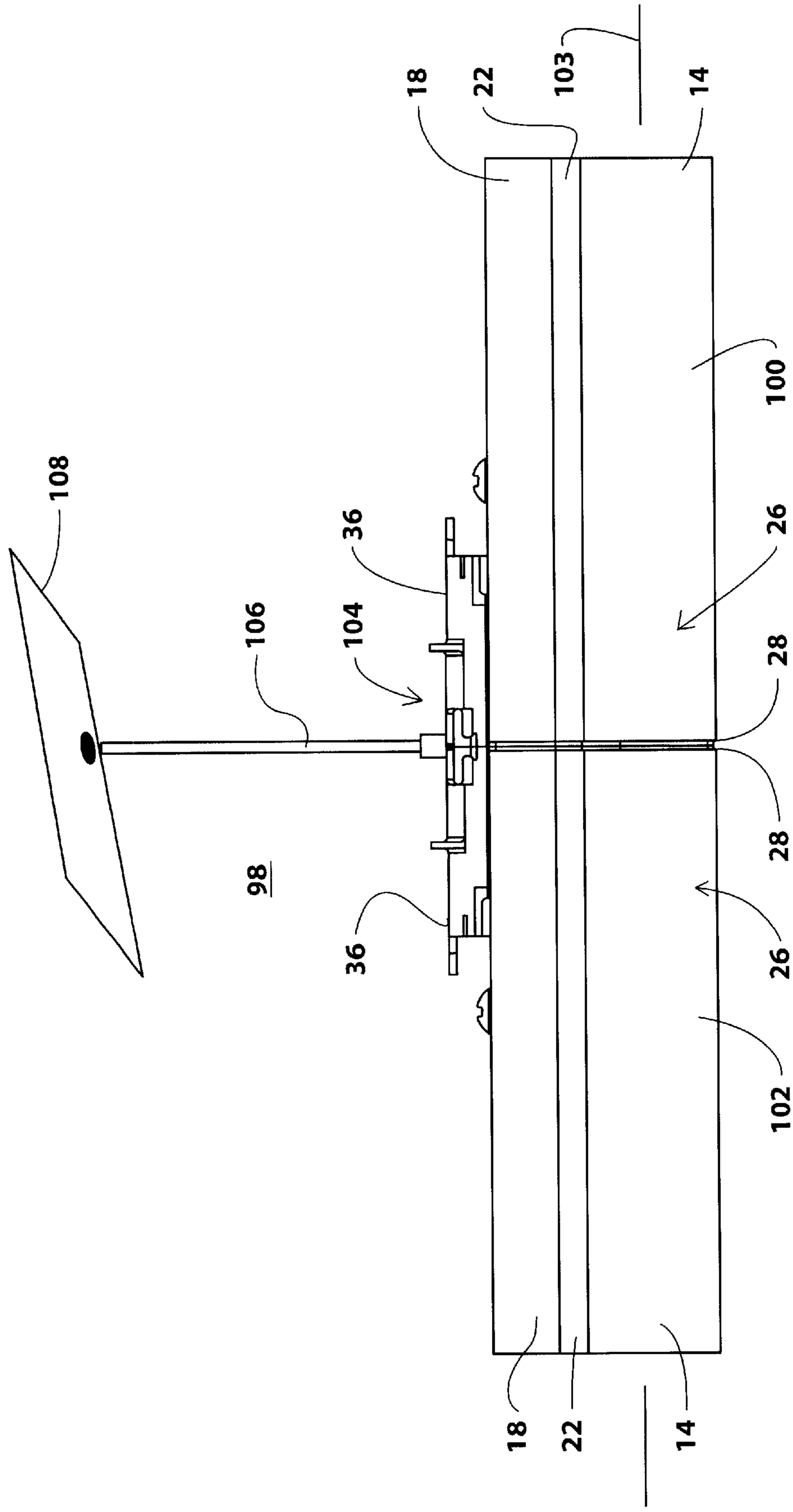

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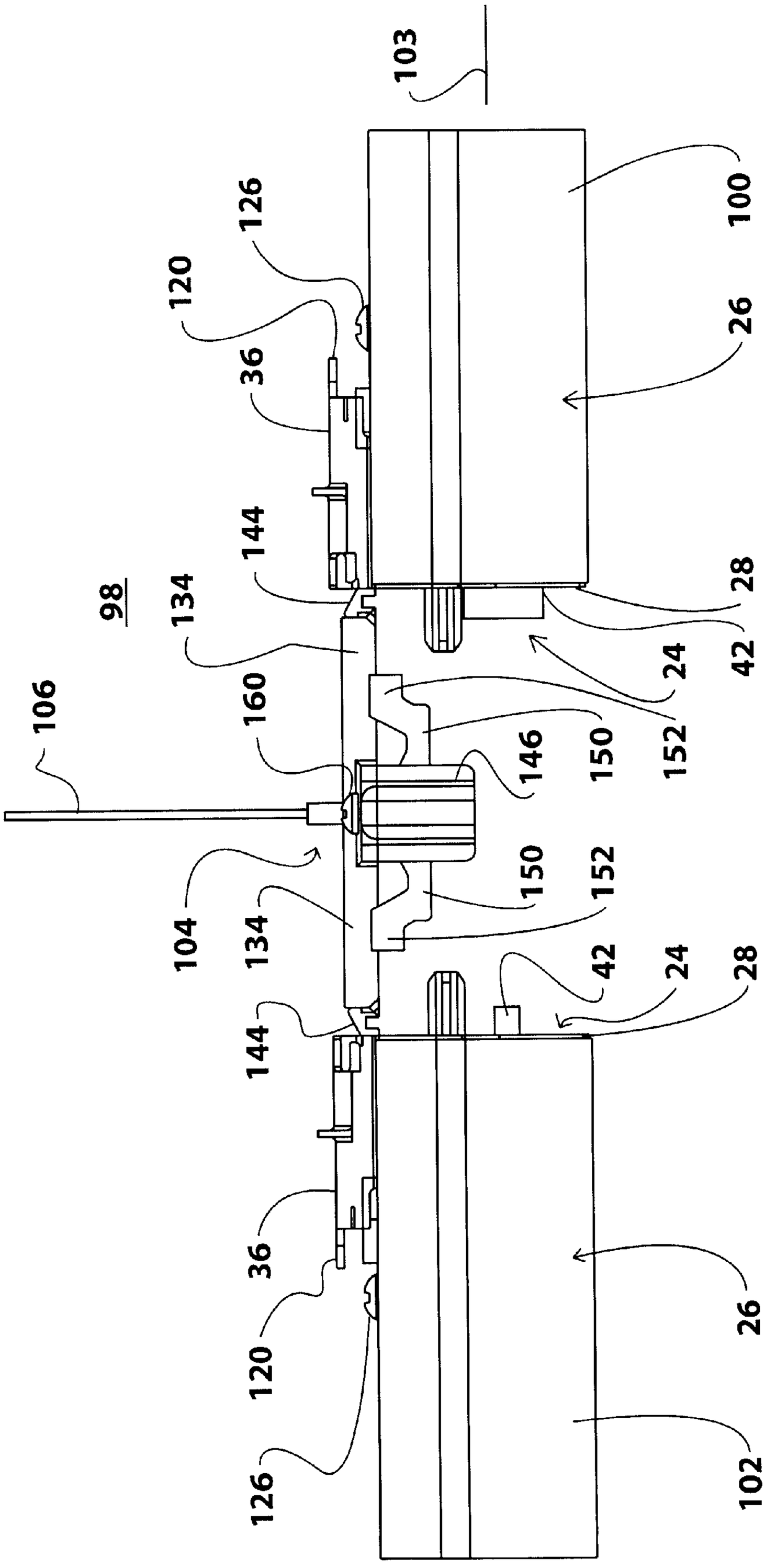
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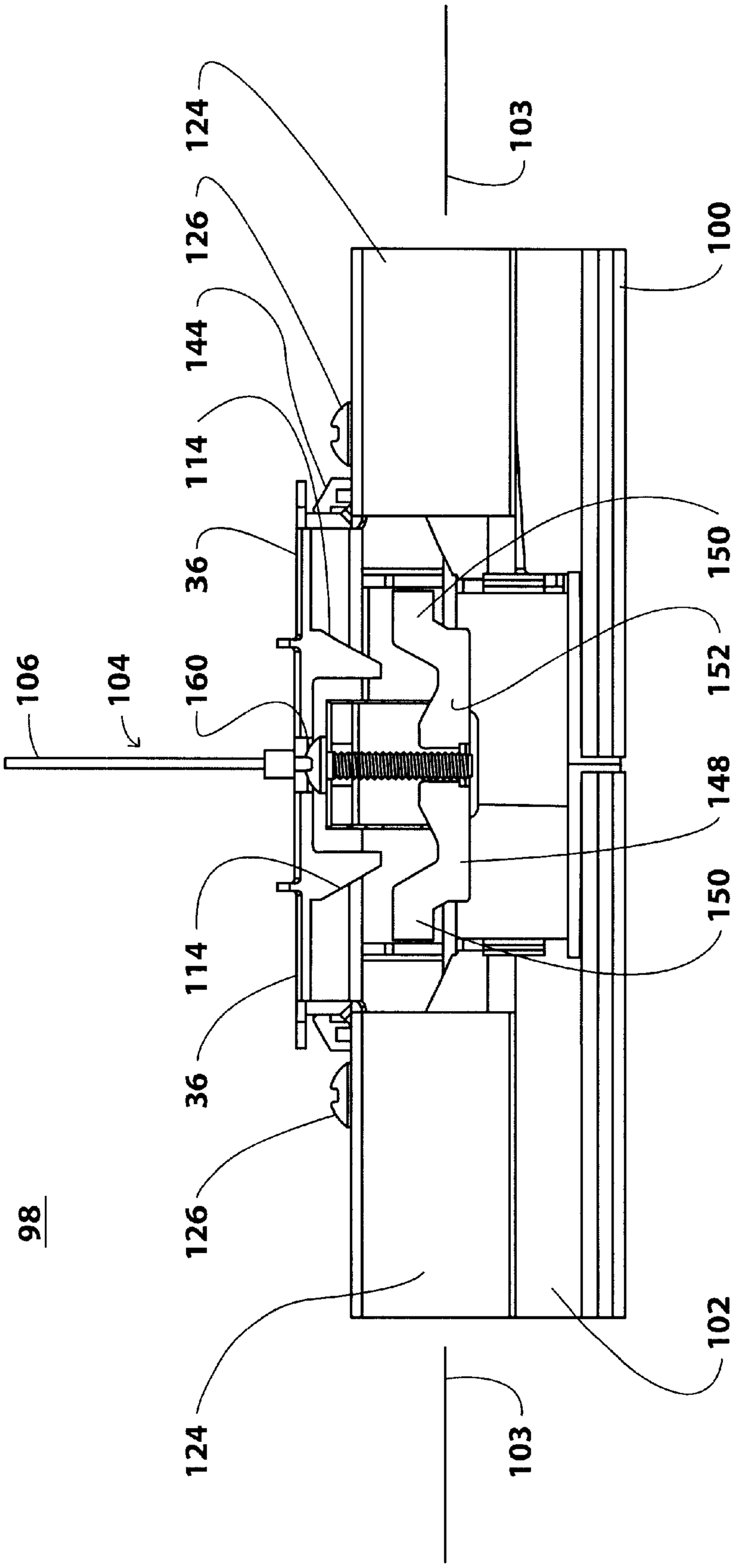
FIGURE 10



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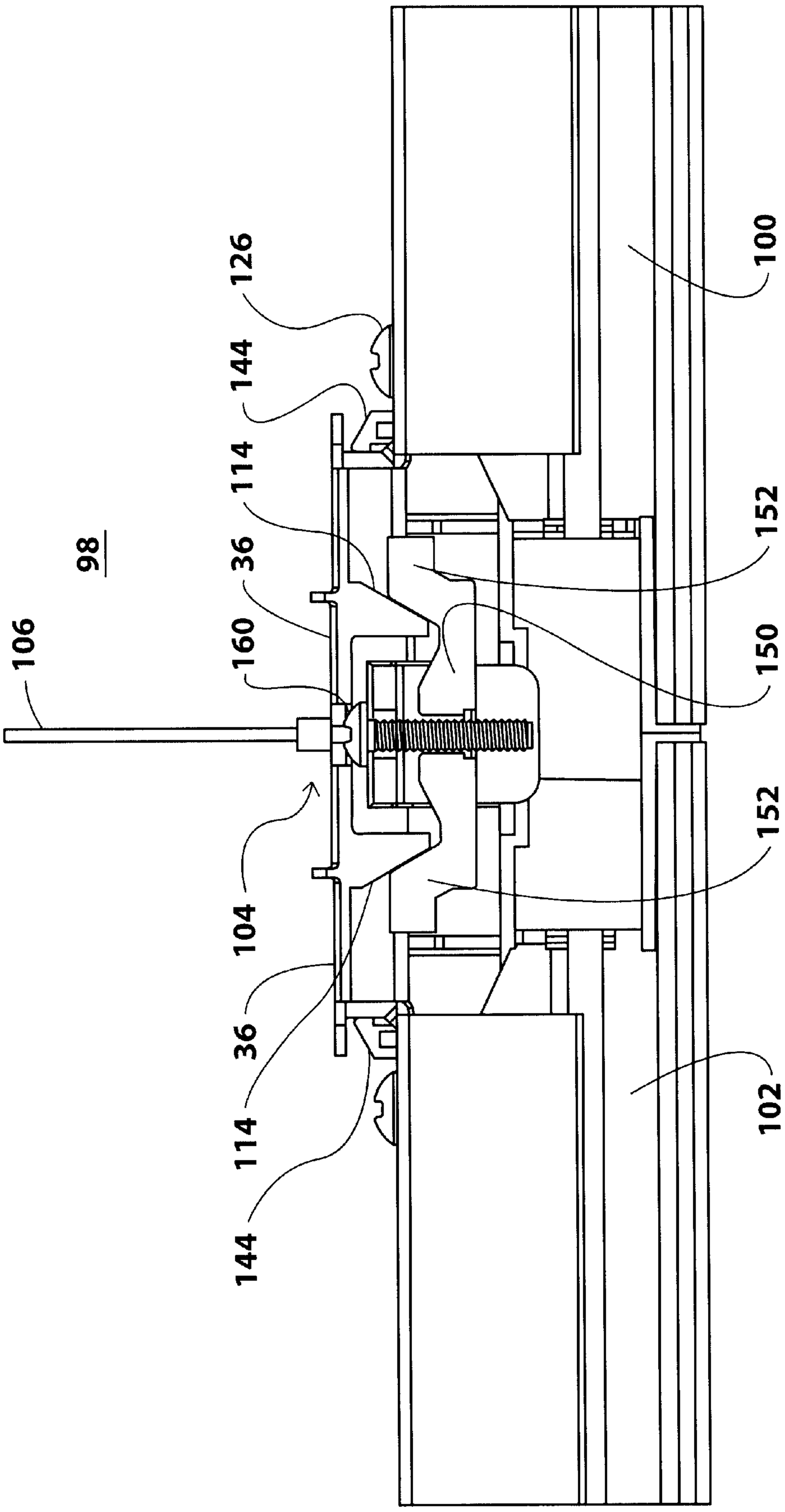

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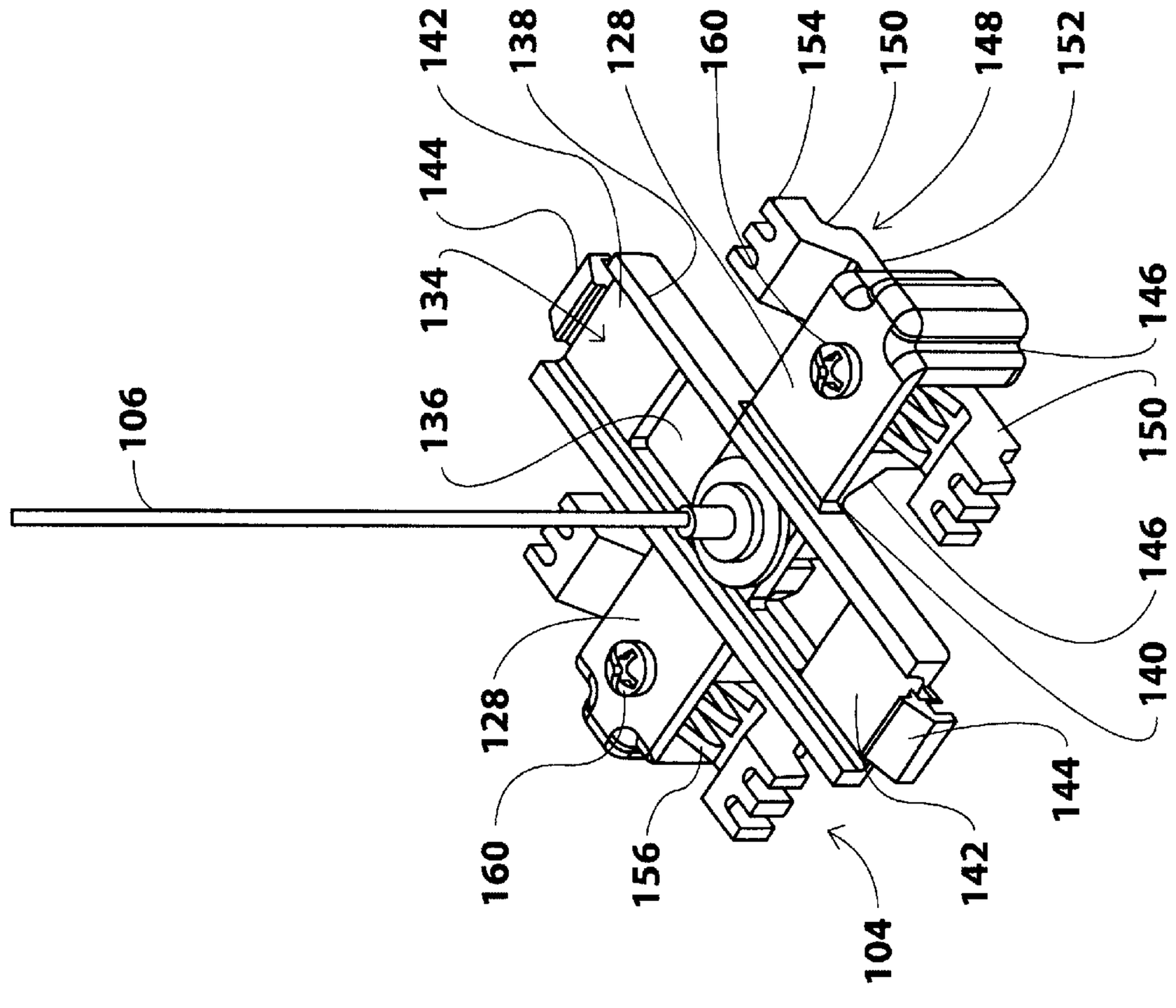

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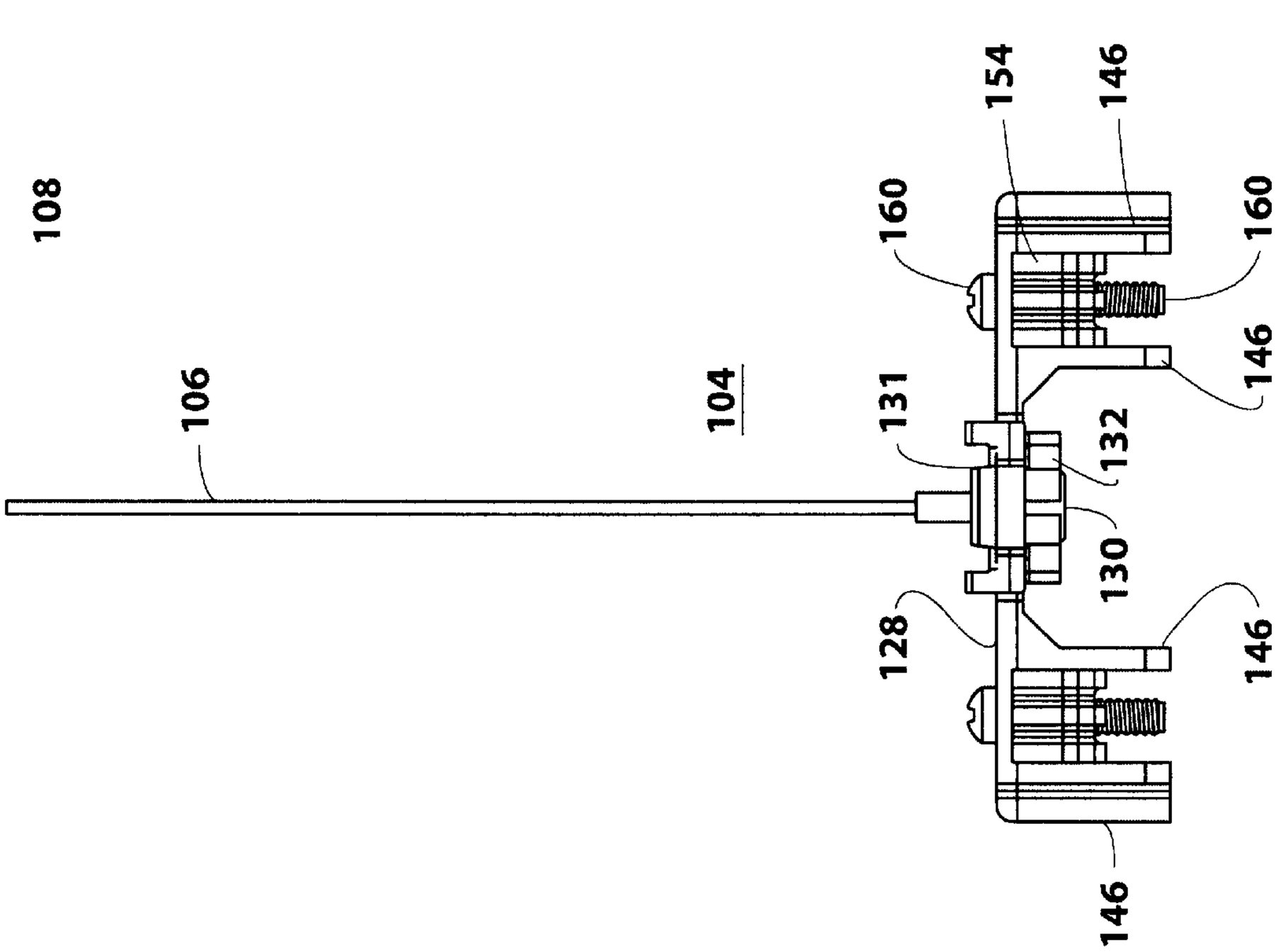

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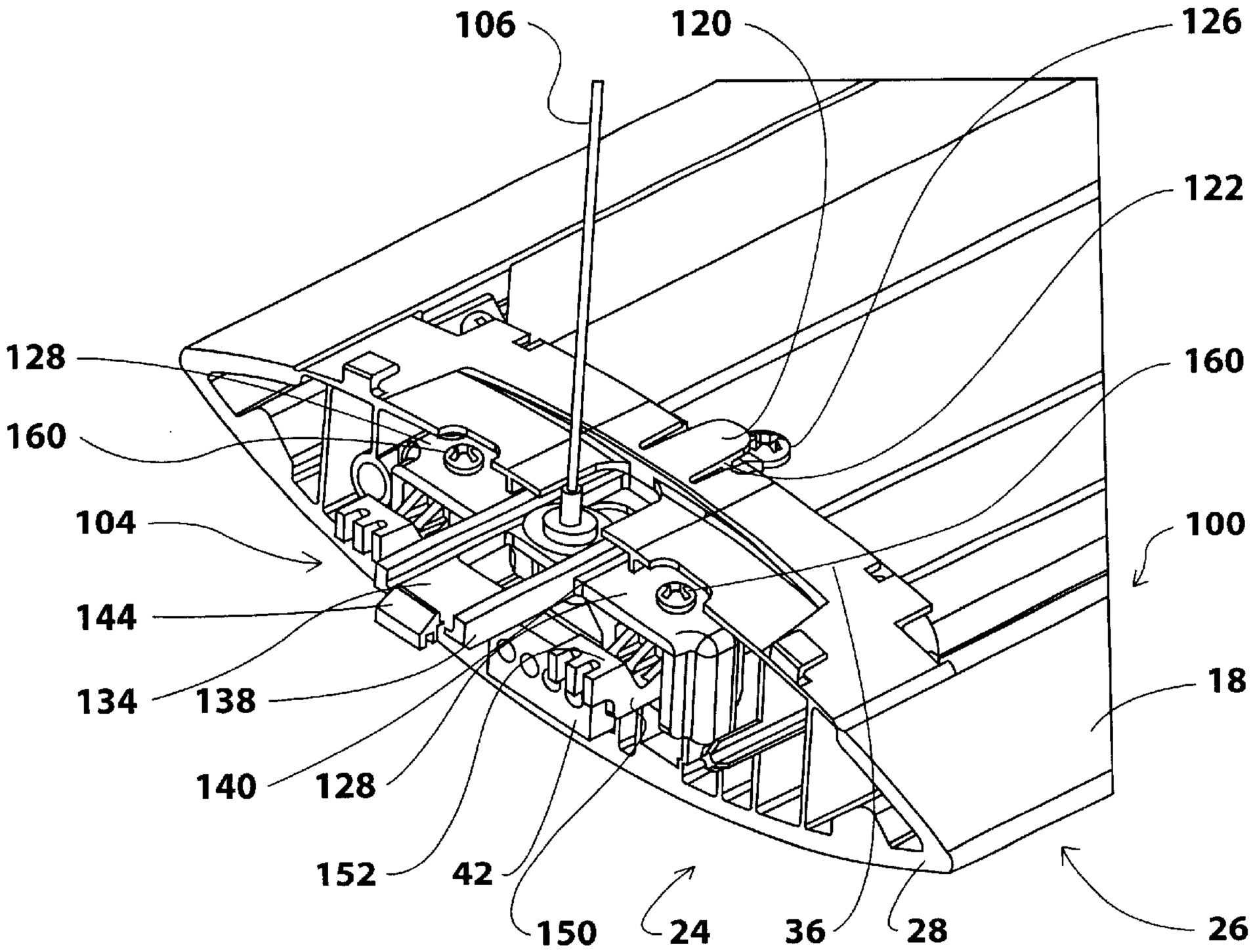

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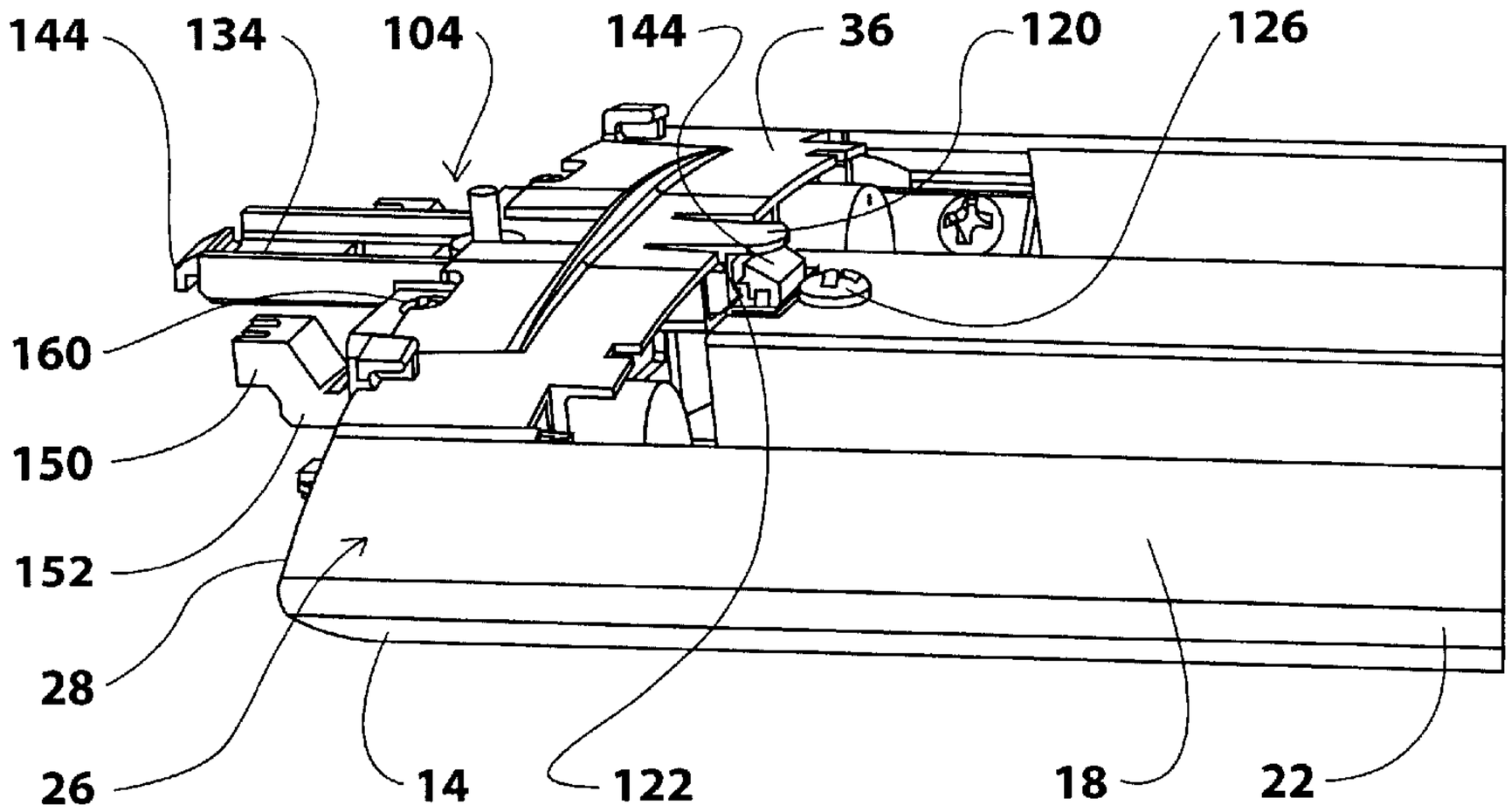

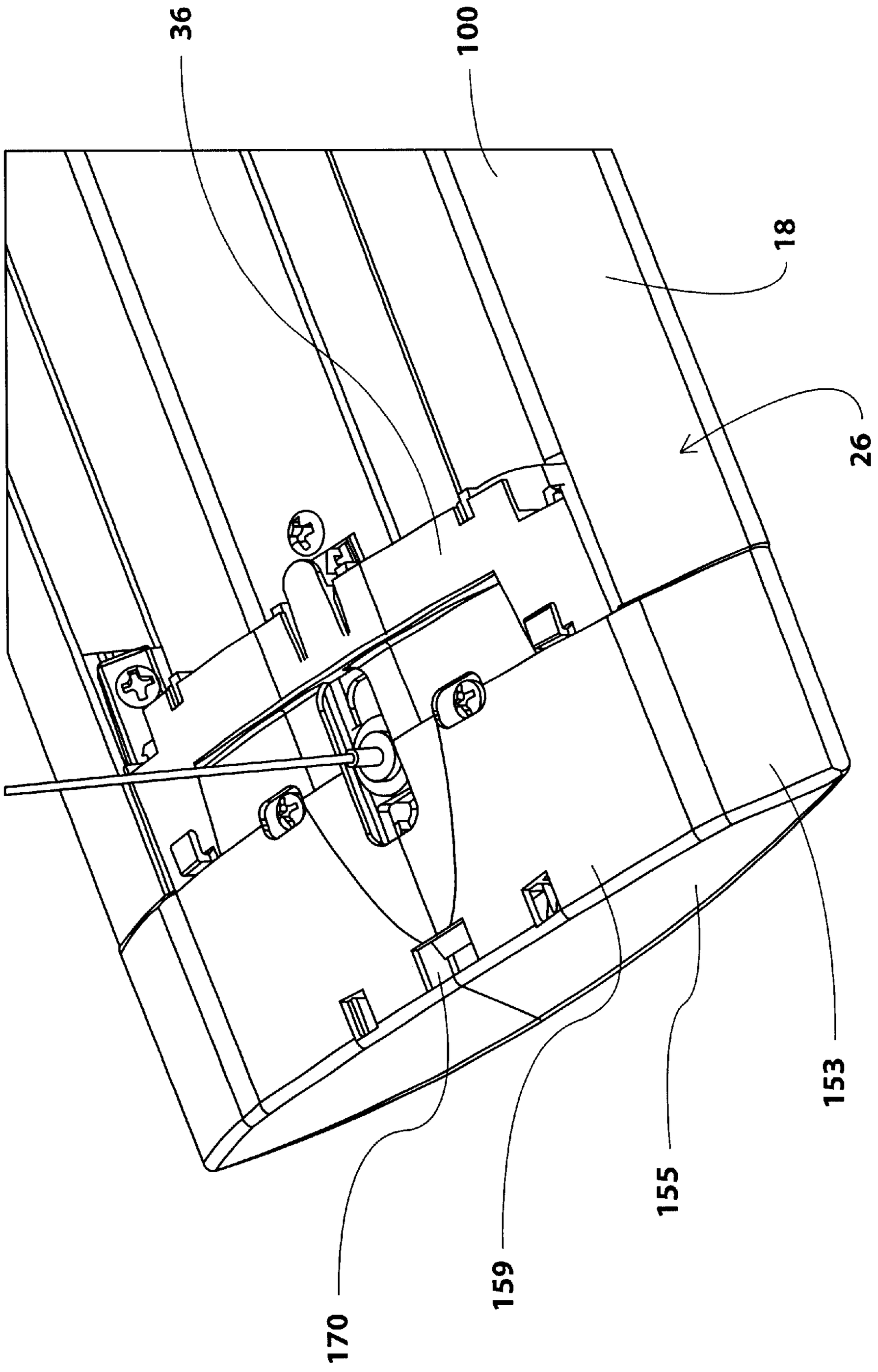

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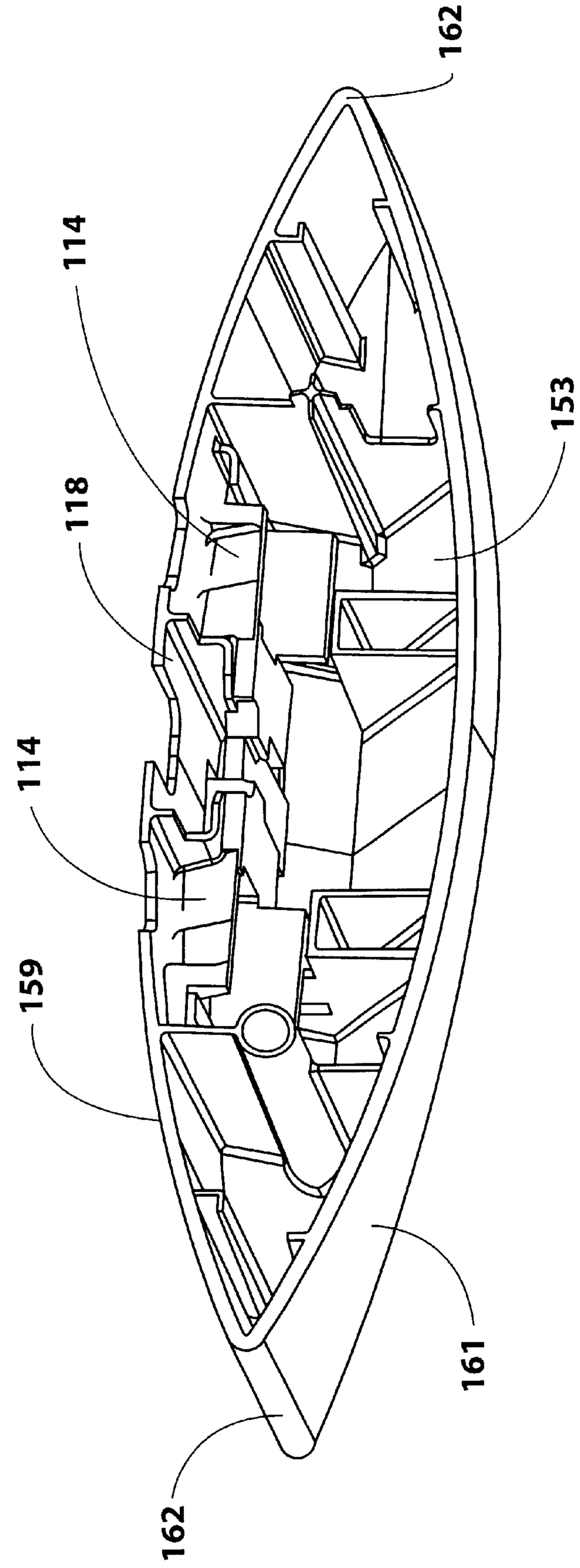

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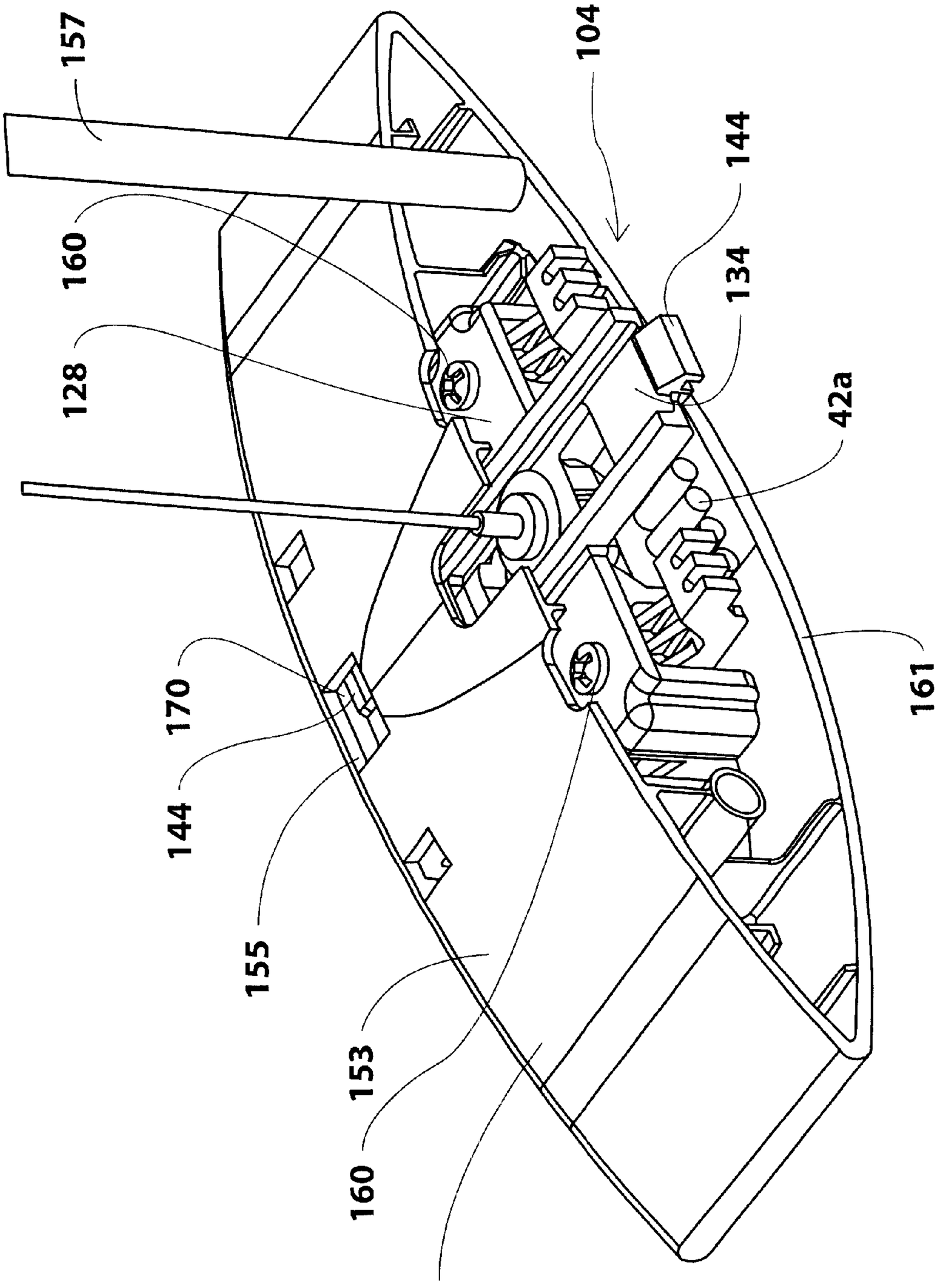

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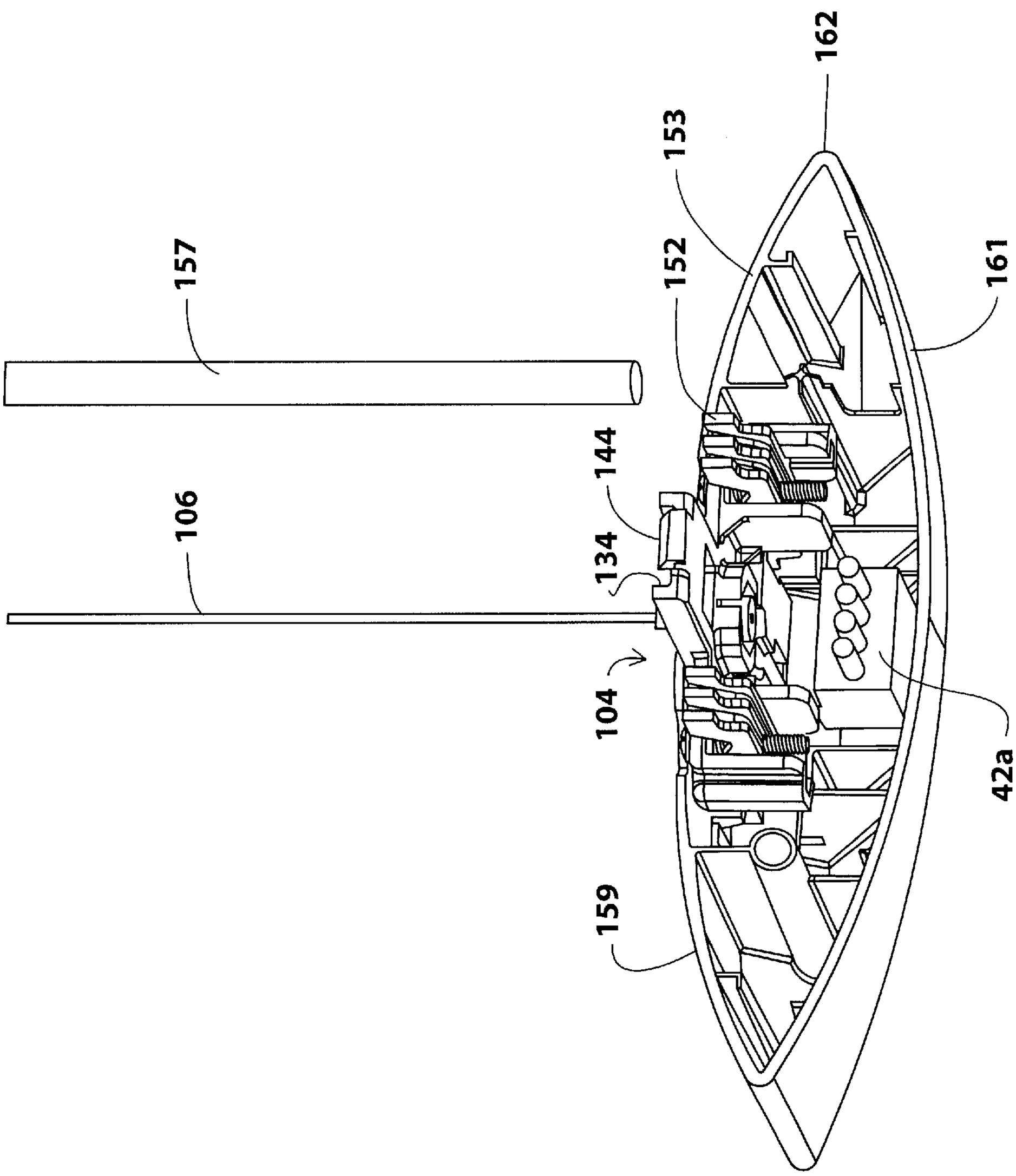

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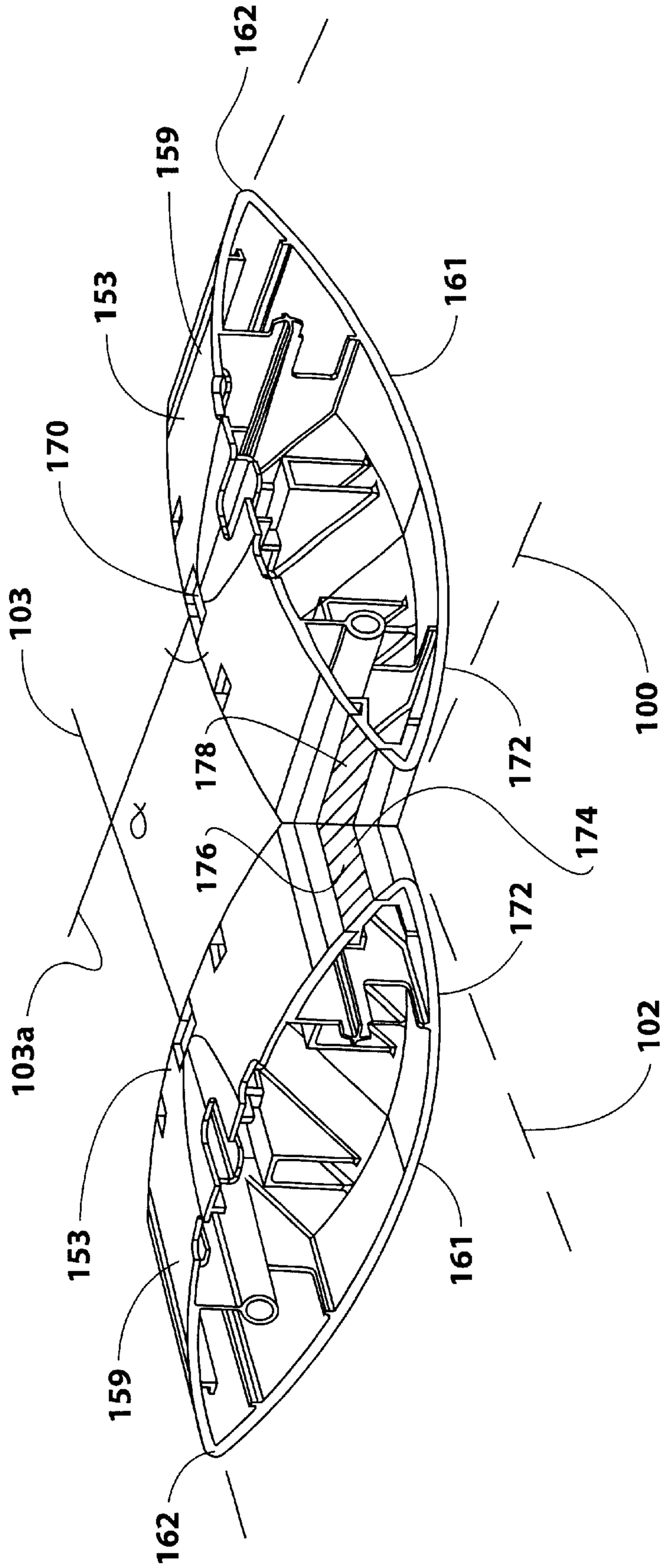
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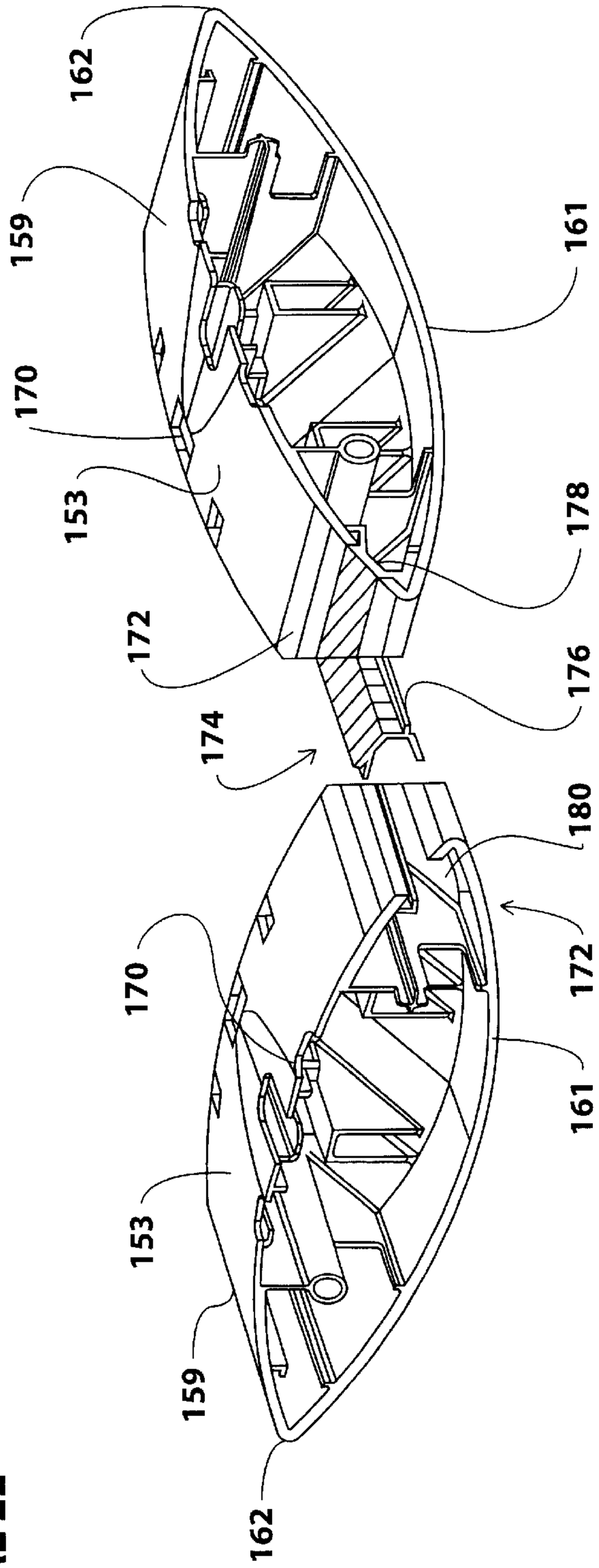
FIGURE 21



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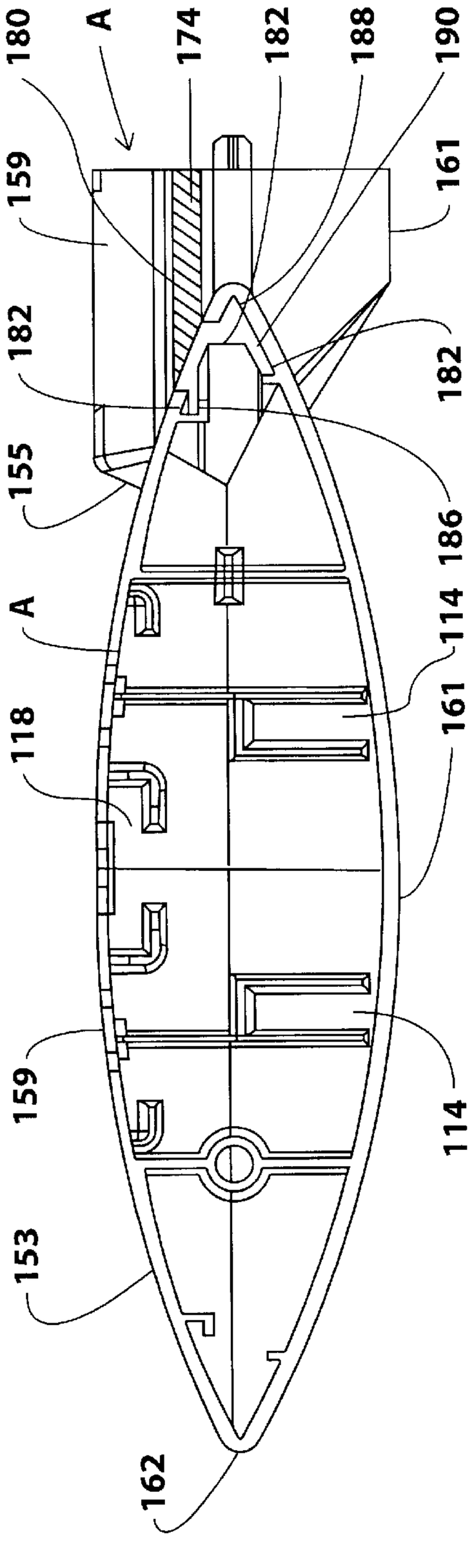

FIGURE 23

LINEAR FIXTURE SUSPENSION SYSTEM

FIELD OF THE INVENTION

The present invention relates to joint and mounting assemblies for suspended linear structures, particularly to a suspension system for suspending and joining two adjacent lighting fixtures.

BACKGROUND OF THE INVENTION

Modular suspended linear fixtures are typically assembled in place by connecting and mounting individual modules. Typical linear fixtures are suspended from an overhead structure and include linear fluorescent lighting systems. Such lighting fixtures may radiate light upwardly against the ceiling or downwardly towards the work area. Imprecise interfitting of such a modular lighting systems results in an unsightly and unprofessional appearance and spaces between the completed assembly, through which light radiates when switched on.

Typically these assemblies are suspended at heights of 7 ft. or more from the floor. Mounted and joining prior art structures entails cumbersome, and sometimes dangerous, procedures.

One typical hanger mounting assembly is a disclosed in U.S. Pat. No. 5,282,600 issued Feb. 1, 1994, to Weiss, et al. This patent discloses a U-shaped hanger adapted to be attached to a washer and a wire for suspension from an overhead structure. The hanger further includes two circular openings through which extend cylindrical type protrusions extending from joiners of adjacent lighting fixtures extend and into corresponding openings in the joiner system of the adjoining linear lighting fixture. Additional openings are provided to the joiners through which wires may be fed by an electrician for connection to ballast and lighting contained by lighting fixtures. Furthermore, screws are inserted through adjacent openings in the joiners to hold the joiners in abutting relationship. This assembly requires considerable labour above the ground to complete the installation. During the assembly, adjoining fixtures must be screwed together to prevent fixtures from disengaging.

The problem with such a hanger assembly is that it is not quickly adapted to meet the changing needs in present office layouts, which require easy and quick relocation of a lighting system as space requirements change.

There is a need for a linear fixture assembly system that provides for placement of the lighting fixtures relative to the hanger assembly prior to the complete alignment and installation of the hanger assemblies in abutting relationship. There is a need for a linear fixture assembly that can be readily adapted to the changing requirements in office layouts.

SUMMARY OF THE INVENTION

The present invention provides an improvement over the previous typical hanger suspension systems for the linear fixtures by temporarily suspending two adjacent linear fixtures extending generally along a longitudinal axis in a suspended manner from an overhead structure prior to electrical connections, final joining and alignment of the two lighting fixtures. Further the present invention permits for relocation of one or more fixtures by disconnecting the fixtures from adjacent fixtures without having to remove the adjacent fixtures.

The features of the present invention are provided by having joiner supports mounting at each of the end portions

of the linear fixtures. The joiner supports each have a first receiving slot that extends rearwardly from the end portions and is parallel to longitudinal axis. The joiner supports each further include a least one adjacent clamping surface accessible from the end portions. The hanger member is suspended for the wire from the overhead structure and has a bridge member connected to this wire. The hanger member has an elongated alignment member supported by the bridge member having a pair of opposing tongues adapted to be mounted in the receiving slots. Preferably, the tongues are snap-fitted into these first receiving slots and are loosely connected therein to provide an initial mechanical connection that permits for relative vertical displacement of the linear fixtures relative to the hanger member and toward and away from each other over a limited distance.

Furthermore, the tongues preferably have a width less than the width of the first receiving slots permitting the fixtures to be moved transversely of the hanger member to permit the linear fixture to find its center of gravity relative to the hanger member. The hanger member further comprises at least one clamp supported from the bridge member and movable vertically relative to the bridge member. The clamp has two spaced apart wings that are inserted loosely adjacent, each corresponding one of the clamping surfaces in the joiner supports after the tongue has been inserted into the alignment receiving slots permitting the relative adjustment features of the fixture to the hanger member. The clamping member is adjustable, relative to the bridge member, vertically to bring the clamping wings into engagement with clamping surfaces and move the end portions of the linear fixtures along the longitudinal axis towards each other so as to lock the joiner supports to the hanger member and relative to each other. This feature of the present invention allows for a two stage assembly of the linear fixtures to the hanger member. One stage is a temporary stage where a mechanical connection is made to support the fixture from the hanger member and permit relative adjustment. The second stage is the secure connection of the fixture to the hanger member. Consequently, the installer does not have to continue to support the hanger or the linear fixture in place when one or two linear fixtures are suspended in the first stage of connection. The temporary connection is also a safety feature when the fixtures are being disassembled.

When the linear fixture is the last fixture in a lighting fixture layout, the present invention contemplates that this linear fixture has an end portion which is suspended from an overhead structure by the same hanger member as noted above. End caps are mounted by the hanger onto the end portion of the linear fixture by mounting the end cap onto a wing and a tongue of the hanger. The end cap is fitted with or made with a receiving slot to receive one of the tongue members and the end cap has at least one clamping surface to receive the wing. As the clamp member is vertically adjusted, it engages the clamping surfaces of the end cap and moves the end cap into engagement with the joiner support.

In accordance with the present invention, it is envisaged that the joiner supports and the end cap may further be provided with at least one socket in which is mounted a plug type connector. The plug type connector is an electrical connector that engages an adjacent plug type connector in the linear fixture when the clapping member of hanger member is vertically adjusted. This permits for the transfer of some of the electrical control signals and or power between linear fixtures to be supplied to the ballast located the linear fixture for use in association with fluorescent lamps carried by the linear fixture.

In accordance with the present invention, at least one of the tongues and the alignment slots has a resilient locking

member adapted to engage the other of the alignment slots and tongues. Preferably, the locking member comprises a hook-shaped member on an end portion of the elongate alignment member and the first and second alignment receiving slots each has a depending finger adapted to have its tip engage the hook-shaped member.

In accordance with one aspect of the present invention, there is a suspension system for suspending adjacent end portions of first and second linear fixtures extending generally along a longitudinal axis from an overhead structure. The system comprises joiner supports mounted to each of the adjacent end portions of the first and second linear fixtures. The joiner support has adjacent first alignment receiving slots extending inwardly from the end portions, and at least one pair of adjacent clamping surfaces accessible from each of the end portions. The system further comprises a hanger member suspended by a wire from the overhead structure for supporting the first and second linear fixtures from the overhead structure. The hanger member comprises a bridge member connected to the wire, and an elongated alignment member supported by the bridge member and having a pair of opposing tongue insert portions. Each of the tongue insert portions extends along a corresponding one of the adjacent alignment receiving slots of the joiner supports to loosely juxtaposition the end portions of the first and second linear fixtures with the hanger member. The hanger member further comprises at least one clamping member supported from the bridge member for relative vertical movement therewith. The clamping member has two spaced apart wings each adapted to be loosely inserted adjacent a corresponding one of the pair of clamping surfaces when the tongue insert portions are inserted into the alignment receiving slots. The clamping member is movable vertically to bring the wing members into clamping engagement with the clamping surfaces and move the end portions of the linear fixtures into locking engagement.

In accordance with another aspect of the present invention, there is a suspension system for suspending a first end portion of a linear fixture having a longitudinal axis from an overhead structure. The system comprises a joiner support mounted to the first end portion. The joiner support has a first alignment receiving slot extending inwardly from the first end portion, and at least one first clamping surface accessible from the first end portion. The system includes an end cap for capping the first end portion of the linear fixture. The end cap has an open end portion having a second alignment receiving slot extending inwardly of the open end portion, and adjacent the first alignment receiving slot. The cap has at least one second clamping surface accessible from the open end portion adjacent the first clamping surface. The system further comprises a hanger member suspended by a wire from the overhead structure for supporting the linear fixture and the end cap from the overhead structure. The hanger member comprises a bridge member connected to said wire and an elongated alignment member supported by the bridge member having a pair of opposing tongue insert portions. Each of the tongue insert portions extends along a corresponding one of the first and second alignment receiving slots of the joiner support and end cap to loosely juxtaposition the first end portion of the linear fixture with the open end portion of the end cap and the hanger member. The hanger member has at least one clamping member supported from the bridge member for relative vertical movement therewith. The clamping member has two spaced apart wings each adapted to loosely engage a corresponding one of the first and second clamping surfaces when the tongue insert portions are inserted into the alignment first and second receiving slots. The clamping member is moved vertically to bring the wing members into clamping engagement with the first and second clamping surfaces and move the first end portion of the linear fixture and the open end portion of the end cap into locking engagement with the hanger member.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and its advantages will become more apparent to those skilled in the art by reference to the following drawings in conjunction with the accompanying specification, in which:

FIG. **1** is a perspective view of a linear lighting fixture of the preferred embodiment;

FIG. **2** is an enlarged partial end view of the linear lighting fixture of FIG. **1**;

FIG. **3** is a front end view of the housing support of the linear lighting fixture;

FIG. **4** is a rear end perspective view of the housing support of the linear lighting fixture;

FIG. **5** is a partial rear perspective view of the housing support of the linear lighting fixture;

FIG. **6** is a perspective view of an alternative embodiment of the linear lighting fixture showing the use of a riser extension;

FIG. **7** is an enlarged partial perspective view of the linear lighting fixture of FIG. **6**;

FIG. **8** is an end view of the housing support and riser of the linear lighting fixture of FIG. **6**;

FIG. **9** is a side elevational view showing the suspension system for suspending two linear lighting fixtures from an over-head structure;

FIGS. **10** to **12** show the stages of connecting and suspending the linear lighting fixtures prior to complete assembly as shown in FIG. **9**;

FIG. **13** is a side view of the hanger member used to suspend the linear lighting fixtures;

FIG. **14** is a perspective view of the hanger member of FIG. **13**;

FIGS. **15** and **16** are partial perspective views showing the insertion of the hanger member in a joiner support in accordance with the connection as shown in FIG. **11**;

FIG. **17** is a perspective view showing the suspension of a linear lighting fixture and end cap from the preferred suspension system;

FIG. **18** is a perspective end view of the cap;

FIGS. **19** and **20** are perspective views showing the hanger member mounted in the end cap;

FIG. **21** is a perspective view showing the manner in which end caps are joined for a linear lighting fixture layout;

FIG. **22** is a partially exploded view of FIG. **21**; and

FIG. **23** is a side elevational perspective of FIG. **21**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIGS. **1** and **2**, there is shown a linear lighting fixture **10** for suspension from an overhead structure. The linear lighting fixture **10** has fluorescent lamps **11** for the purposes of illuminating commercial, office, or home space. The fixture **10** has an elongated linear housing **12** that includes a bottom wall **14** and a top wall **16**. The top wall **16** has an elongated slot **18** extending longitudinally along the top wall **16** of the housing **12**. The elongated slot **18** extends

the entire length of the lighting fixture **10** to divide the top wall **16** into two top wall surface portions **20**. The housing **12** comprises an extruded aluminum material and is formed at with a corner **22** between the top wall **16** and bottom wall **14**.

The linear lighting fixture **10** further includes a one-piece or molded piece plastic housing support **24** which is shown in FIGS. **1** to **5**. Alternatively the support **24** may be formed and assembled from multiple pieces. The plastic housing supports **24** are shown mounted within the housing **12** located at opposing end portions **26** of the housing **12**. It should be understood that additional linear supports may be provided along the length of the housing **12** when the housings are of length to accommodate two or more fluorescent lamps **11** mounted through suitable connections in end to end relationship within one linear housing **10**. The use of the molded plastic support **24** results in a weight reduction to a fixture of less than 12 pounds. Current building codes for such a lightweight fixture do not require additional suspension.

The housing support **24** is matingly inserted into the housing **12** between the housing top wall **16** and housing bottom wall **14**. The housing support **24** has a peripheral flange **28** that abuts against edge or peripheral edges **30** of the housing bottom and top walls **14**, **16** at the end portions **26**. The abutment of the peripheral flange **28** against the peripheral edge **30** limits the insertion of the housing support **24** into the housing **12** and precludes or limits leakage of light from the end of the fixture **10**. Further, the peripheral flange **28** of the housing support **24** provides a peripheral surface which for the most part extends around the peripheral edge **30** of the housing support **24** to provide a relatively flat surface that abuts against other flat surfaces of housing support of other adjoining linear lighting fixtures to be mounted in linear adjacent relationship with the fixture **10**.

In FIGS. **3** and **4**, the housing support **24** has bottom surface portions **32** and bottom surface ridges **33**. The housing supports **24** further include top surface portions **34**. The bottom surface portions **32**, bottom surface ridges **33** and the top surface portions **34** conform in shape respectively to the housing bottom wall **14** and the housing top wall **16**. Thus, the bottom surface portions **32** and the bottom surface ridges **33** act with the top surface portions **34** of the housing support to engage in mating slide fitting relationship the housing bottom walls or portions of these bottom walls **14** and portions of the top walls **16**. The angle at which the top wall portions **20** are bent about corners **22** with respect to the bottom housing walls **14** may be chosen such that this angle is slightly less than the angle between the bottom surface portions **32** and the top surface portions **34** of the housing support **24**. This will provide a tight fit for the housing support **24** when inserted into the housing **12**. Further, the housing support **24** acts to support or maintain the elongated housing bottom wall **14** in a fixed spaced apart relationship from the housing top wall **16**.

In the preferred embodiment shown in the drawings, the elongated housing bottom wall **14** and the elongated housing top wall **16** have a cross-sectional shape in the form of an eyelet with the elongated housing bottom wall **14** and the elongated housing top wall **16** meet at the corners **22** of the eyelet. The elongated slot **18** extends along the entire length of the elongated housing top wall **16** so as to provide two spaced apart housing top wall portions **20**. Such an elongated slot **18** extending the entire length of the fixture **10**, permits for significant material reduction and less material wastage in the production of the housing **12**.

To provide additional strength to support the housing **12**, the housing support **24** has a raised bridge surface **36** that extends transversely across the elongated slot **18** at end portion **26** of the housing **12**. This raised bridge surface **36** provides a continuous or continuum in the surface across the end portions **26** between the elongated housing top wall surface portions **20**.

The housing support **24** further has a series of ridges **38** and struts **40**, which provide additional reinforcing strength in the housing support **24**. The housing support **24** is further adapted to be suspended from an overhead structure. This feature of the housing support **24** is disclosed in more detail hereinafter.

The linear lighting fixture **10** thus far described has the advantage that it is a light weight fixture of a relatively thin gauge of aluminum sheet material extruded or formed into shape and the housing supports **24** are of molded plastic. It should be understood that the light weight linear lighting fixture **10** has advantage in that it is more easily handled by installers during installation from suspended structures which are sometimes in the order of 7 feet or more above the ground. Further, the lighter the fixture **10**, the less support required from the overhead structure to support the fixture **10**.

Referring again to FIGS. **1** through **5**, another feature of the end support **24** is shown as a plug type electrical connector **42** housed within the support **24**. The supports **24** further include a first socket or first connector recess **44** that extends through the housing support **24**. From the drawings it will be seen that the connector **42** is generally in the shape of a rectangular cross-section and the shape of the connector recess **44** also follows the shape **42** of the electrical connector. The electrical connector **42** is shown to be a plug type connector. In the particular drawing shown, four circular apertures are shown as female apertures for reception of a male connector. It should be understood that the connector **42** may be a male or a female connector or may be both in that it could be a coaxial type of connector. In accordance with the present invention, the type of connector used for transferring of electrical power or control signals between adjacent mounted linear lighting fixtures **10** is a plug type connector. That is for the purposes of the present invention, the connectors **42** of two adjacent linear lighting fixtures **10** are adapted to abut and matingly engage each other when the linear lighting fixtures **10** are mounted in side by side longitudinal abutting or adjoining relationship.

Because the shape of the first connector recess **44** conforms to the shape of the first electrical plug connector **42**, the first electrical plug connector **42** is seated in a partially mating relationship with the first connector recess. The first connector recess **44** has a pair of opposing support walls or side support walls **46** which engage the first plug connector **42** to seat the first plug connector in the first connector recess **44**. The first connector recess **44** further includes a pair of opposing converging cantilever walls **48** which further include in-turned hook members **50** which engage a rear surface of the connector **42**. In FIG. **4**, the housing support **24** has a bottom wall portion **52** extending between the bottom surface ridges or ribs **33** and below the connector **42**. The bottom wall portion **52** has two upstanding ribs **54** that are further adapted to matingly engage or positively locate the electrical connector **42** seated within the first connector recess **44**. The hook members **50** engage the first electrical plug connector **42** to positively locate the travel of the first electrical plug connector **42** into and through the first connector recess **44**. The first electrical power connector **42** has a front face **56** having connection terminals **58** facing outwardly of the housing **10** and the end portions **26** of the housing **10**. The plug connector **42** has a rear surface **60** with

electrical wiring (not shown) extending therefrom for connection with ballast or other circuitry housed within the linear lighting fixture **10**.

The electrical connector **42** is readily inserted into the end support **24** by threading the wire through the open recess or first connector recess **44** and then fitting the first electrical connector **42** in sliding mating relationship into the first connector recess **44** until the converging cantilever side walls **48** and the hook members **50** engage the connector **42**. This provides for easy assembly of the electrical connector **42** within the end support **24**. This also provides for the housing support or end support **24** to be readily inserted into the housing **12** in a plant facility with the wiring or wires **62** connected at the manufacturing facility to a ballast. Consequently, no additional wiring in the field is required during installation for the fixture.

The housing supports **24** located at each end portion **26** of the housing **12** have two additional second electrical control plug connectors that are seated in second connector recesses **66**. The second plug connectors **64** have a front face **68** having a connection terminal facing outwardly of the housing for connection with a control source. The second plug connectors **64** have a rear face (not shown) with electrical control wiring extending from the second plug connector **64** through the housing support **24** and into the linear housing **10**. The construction of the support walls of the second connector recess **66** are similar to that for the first connector recess **42**. That is to say, the connector recess **66** includes second supporting opposing support walls or side walls **72** which engage the second plug connector **64** to seat the second plug connector **64** in the second connector recess **66**. The second connector recess **66** further includes rearwardly extending opposing cantilevered walls **74** that converge and are provided with in-turned hook members **76** which are mounted to the cantilevered walls **74**. The in-turned hook members **76** are in-turned to engage the second electric plug connector **64** and to positively locate the travel of the second electrical plug connector **64** into and through the second connector recess **66**.

Referring to FIG. **4**, there is shown on the bridge surface **36** of the support **24** a pair of opposing locking tabs **78** and a pair of spring tab hooks **80** below bridge surface **36**. Also provided on the support **24** are rearwardly or inwardly facing ears **81** having openings **82** through which locking screws **84** (FIG. **7**) pass. The purpose of the locking tabs **78**, hooks **80**, and ears **81** is to provide for a riser support or member **92** for supporting a lamp fixture **11** as shown in FIGS. **6**, **7**, and **8**. In these figures, the lamp **11** is located at a raised elevation relative to the housing **10** and the housing support **24**. This type of fixture is provided to have a different lighting effect. In the fixture shown in FIGS. **6** and **7**, two elongated housing side walls **86** extend the length of the adjacent respective top wall portions **20**. The two elongated housing side walls **86** are secured relative to the top housing wall **18** and the bottom housing wall **14** by means of locking screws **84** extending through the opening **82** and ears **81** to positively locate one side surface of the side walls **86** in force abutting relationship against the in-turned edge **88** of the housing top wall portion **20**. The side walls **86** are further mounted in place in abutting relation at their end against flanges **90** which form part of a riser member **92**. The riser members **92** are mounted by sliding edge portions thereof over the hook **78** and are also provided with **20** openings **94** to hook members **80** of the housing support **24** extend. The riser member **92** is further provided with a socket **96** adapted to receive the lamp **11**. This feature of being able to modify the construction of the linear lighting fixture **10** to include the riser support **92** and the additional or alternative lamp **11** allows for the manufacture of a more flexible linear lighting fixture **10**.

Thus far in the description of the preferred lighting fixture **10** of the present invention, the description has been limited to the construction of the fixture **10** itself to include a housing **12** and a housing support **24**. Further modification to the housing **12** has been provided by the addition of housing side walls **86** and a riser member **92**. As is stated previously, the housing support **24** may be further adapted to support the linear lighting fixture **10** from an overhead structure. The housing support **24** is also previously described to include a peripheral flange **28** which was adapted to lie flush in mating engagement or abutting relationship with another end support **24** and the linear lighting fixture **10**. To explain this feature of the linear lighting fixture and in particular the housing support **24**, reference is made to FIGS. **9** through **20** for which a linear lighting fixture suspension system is shown.

Referring to FIGS. **9** through **12**, there is shown a suspension system **98** for suspending adjacent end portions **26** of the first linear lighting fixture **100** and a second linear lighting fixture **102** that extend generally along longitudinal axis **103**. The suspension system suspends the linear lighting fixtures **100**, **102** from overhead structure **108** in a manner to be hereinafter described.

Previously, reference had been made to housing supports **24**. For the purposes hereinafter described, these housing supports **24** are referred to as joiner supports **24**. All similar features and numbers will be used for the joiner supports **24** as have been used previously for the housing supports **24**. The term joiner supports **24** is used in this aspect of the present invention to further exemplify that the supports **24** have a function that goes beyond the supporting the housing of the linear lighting fixture to that of supporting adjoining linear lighting fixtures **100** and **102**. The joiner supports **24** are shown as before mounted to each of the adjacent end portions **26** of the first and second linear lighting fixtures **100**, **102**. The jointer supports **24** have their peripheral flanges **28** shown in abutting relationship in FIG. **9**. These flanges **28** are brought into abutment during the assembly of the fixtures **100**, **102** on the suspension system **98**. The joiner supports **24** have a pair of spaced apart inclined clamping walls **114** which are shown in FIGS. **2** and **3** mounted from or suspended from the bridge surface **36** of the joiner support **24**. The inclined clamping walls **114** are further shown in the cross-section of FIGS. **11** and **12**. Each of the inclined clamping walls **114** is accessible from a respective end portion of the joiner support **24** which is labeled numeral **116** showing the view into the end of the joiner support **24** of FIG. **3**. Each of the clamping walls **114** slopes upwardly of the longitudinal access **103** and inwardly of the respective end portion **116** or the end portion defined by the peripheral flange **28** of the joiner support **24**.

The adjacent joiner supports **24** of the fixtures **100** and **102** have first adjacent alignment receiving slots **118**. The alignment receiving slots **118** each have a depending finger **120** that extends rearwardly of the bridge **36** of the joiner support **24**. The depending finger **120** has a transverse rib **122**.

Mounted within the lighting fixtures **100** and **102** is a reflector support **124** which is located by a locating screw **126**. The locating screw **126** serves another purpose which is discussed hereinafter.

The suspension system further includes a hanger member generally designated **104** and shown as a component part in

FIGS. **13** and **14**. The hanger member **104** is suspended from the overhead structure **108** by wire **106**. The purpose of the hanger member **104** is to support the first and second linear lighting fixtures **100** and **102** from the overhead structure **108**.

The hanger member **104** has a bridge member **128** adapted to extend transversely of the longitudinal axis **103**. The bridge member **128** has an opening **131** through which the wire **106** passes to a washer **130** mounted within a socket **132**. The washer **130** mounted within socket **132** permits for relative floating of the bridge member **128** with respect to the wire **106** so that the bridge member **128** may be suspended in a plum fashion from the overhead structure **108**.

The bridge member **128** has an elongate alignment member **134** which in turn has an opening **136** therein to allow for the wire **106** and washer **130** assembly to be mounted to the bridge structure **128**. The elongate alignment member **134** has side walls **138** which are seated within guide walls **140** of the bridge member so as to positively locate the alignment member **134** to the bridge member **128**. The alignment member **128** has a pair of opposing tongues **142**. The pair of opposing tongues **142** or tongue insert portions **142** are adapted to extend along one of the adjacent alignment receiving slots **118**. The tongue portions **142** are terminated in an upwardly directed resilient hook member **144**. The tongue portions **142** have a width less than the width of the receiving slots **118** to permit relative lateral movement therewith.

The bridge member **128** has two downwardly depending ribs or side wall supports **146**. Suspended between the ribs **146** from each side of the bridge **128** is a generally V-shaped wing member **148** having two spaced apart wings **150** and a central interconnecting member **152**. The ends of the wings **150** are shown with a series of reinforcing fingers **154** and the central portions of the interconnecting member **152** are shown with a series of reinforcing ribs **156**. A vertically adjustment screw **160** passes through the bridge member **128** between side supporting walls or ribs **146** to support or hold the interconnecting member **152** in a depending fashion from the bridge member **128**.

The assembly of the two linear lighting fixtures **100** and **102** as shown in FIG. **9**, is described with reference to FIGS. **10** to **12**.

In FIG. **10**, the hanger member **104** is suspended from the overhead structure **108** by wire **106**. Next, the linear lighting fixtures **100** and **102** are positioned adjacent to the hanger member **104**. It should be understood that for the purposes of this drawing, the two linear lighting fixtures are shown positioned along a longitudinal axis **103**. However, in practice, one linear lighting fixture would be orientated along linear axis **103** for temporary connection to the hanger assembly **104** and then the second linear lighting fixture **102** is also temporarily connected to the hanger assembly **104** prior to secure connection. By temporary connection it is meant that the loose connection of the linear lighting fixtures **100** and **102** as shown in FIG. **11**.

In FIG. **11**, the elongate alignment member **134** has been inserted into the alignment receiving slot **118** of the joiner support **24**. The alignment member **134** has its corresponding tongue portion **142** inserted into alignment receiving slot **118** until the hook **144** passes the tongue **120** and is locked in place relative to the depending rib structure **122**. Once either fixture **100** or fixture **102** is so connected, the other fixture **100** or **102** may also be so connected. It should also be noted from FIG. **11** that the wing-shaped clamping member or clamp comprising the interconnecting member **150** and the wings **152** are positioned adjacent and in loose relationship with the ramp or clamping inclined walls **114** of the joiner support **24**. This permits for a loose mechanical connection of the linear lighting fixtures **100** and/or **102** relative to the hanger member **104** for relative longitudinal and lateral adjustment. Once so connected, the linear lighting fixtures **100** and **102** do not have to be physically supported by an installer. Furthermore, the assembly of the elongate support member **134** within the first alignment receiving slot **118** is a loose connection which provides for some relative movement between the linear lighting fixtures **100** and **102** and hanger number **104**.

Referring to FIG. **10**, the connectors **42** of each of the end portions **26** is shown with a male connector on the linear lighting fixture **102** and the female connector on the linear lighting fixture **100**. These plug connections **42** are partially or temporarily made during the assembly of the hanger member **104** as shown in FIG. **11**. To complete the assembly and insure a proper mechanical and electrical interconnection between the linear lighting fixtures **100** and **102**, the adjustment screws **160** are rotated to draw up the interconnecting member **150** of the wing shaped clamps **152** so as to bring the wings **152** up into sliding clamping engagement with the inclined walls **114** of the joiner supports **24** as shown in FIG. **12**. This tightly locks the two linear lighting fixtures **100** and **102** in abutting and adjoining relationship with the hanger member **104** whereby the peripheral flanges **28** of the joiner supports **24** abut one another. It also brings the plug connectors **42** into tight electrical contact with each other.

By providing such a system of suspension and connection between two linear lighting fixtures **100** and **102** extending along the same longitudinal access **103**, it is possible to have a temporary supported connection and then have this connection firmly made or disengaged. Furthermore, the linear lighting fixtures **100** and **102** may be readily disassembled by releasing the screws **160** to drop the wing shaped clamp members **152** out of engagement with the inclined clamping walls **114** and then lifting the tab **120** so as to release it from hook **144** so that the elongate member **134** may be removed from the alignment receiving slot **118**. This provides for a flexible linear lighting fixture assembly which may be readily assembled and disassembled to accommodate for different changes in lighting fixture patterns.

Referring to FIGS. **17** through **20**, there is shown an end cap **153** which is adapted to close off the end portion **26** of the fixture **100**. The end caps **153** are utilized in the present invention where the linear extension of the lighting fixtures comes to an end. The end caps **153** provide for a cosmetic and esthetically pleasing cover for the linear lighting fixture **100**, while at the same time providing for a source of power **157** (FIG. **20**) through opening **170** into the male plug connector **42***a* (FIG. **20**).

The end cap **153** has an end wall **155**, a top wall **159**, a bottom wall **161** and edge **162** where the top and bottom walls **158** and **160** meet. The general shape of the end cap **153** is in that of an eyelet and conforms to the shape of the end portion **26** of the fixture **100**. The end cap **153** has an alignment receiving slot **118** and a pair of inclined ramp walls **114** similar to those disclosed previously. The end cap **153** has a power receiving slot **170** adapted to receive wire **157** (FIG. **20**, the connection not shown to simplify the drawing). Wire **157** is connected to connector **42***a*.

Typically, the hanger **104** is inserted into the end cap **153** in a manner identical to that previously described for fixture

102 relative to fixture 100. The hook members 144 pass through an opening 164 in the top wall 159 of the end cap 153. The end cap may have a plastic insert that is snap fitted into place to provide for the ramping surfaces 114 and the completion of the alignment receiving slot 118. The end cap 153 is assembled to a joiner support 24 in much the same manner as two joiner supports 24 are assembled.

Referring to FIGS. 21 through 23, there is shown a method of joining end caps 153 in a non-linear fashion. That is to say, the end caps 170 are joined to a fixture in the same manner as shown in FIGS. 17 to 22. These end caps 153, however, are for linear lighting fixtures that do not extend along the same longitudinal axis previously referred to as 103.

For the sake of simplicity, the end caps shown in FIGS. 21 and 22 do not show the insert required completing the first alignment slot in 118. In the inclined ramps 114, however, the insert has been inserted into FIG. 23 and can be seen at 114 and 118. It should be also understood that between the inclined ramp walls 114 is located the electrical plug connector for connection to a corresponding connector located in joiner support 24 of the linear lighting fixture.

The end caps shown in FIGS. 21 through 23 are shown as able to be joined together at an angle of 90°. Each of the end caps 153 has a side 172 connected to an interconnecting member 174. Interconnecting member 174 has spaced or spread apart legs 176 and 178 that are adapted to be mounted to the sides or respective sides 172 of the two end caps 153.

The linear lighting fixtures are shown by ghost lines 100 and 102 to have respective longitudinal axes 103 and 103*a*. These axes are offset by the predetermined angle alpha (α) which is 90°. The linear lighting fixtures 100 and 102 comprise the same construction as hereinbefore described.

Each of the sides 172 of the end caps 153 has an open or truncated side, which has a slot 180. Each of the end caps 153 has inner surface walls 182 extending adjacent the slot opening 180. The legs 176 and 178 of the interconnecting member 174 have two elongated flanges 186 and 188 that are co-extensive with and are spaced from the opposing sides 182 of each of the respective legs 176 and 178. These flanges 186 and 188 slide along the inner surface walls 182 to maintain the surface of the leg members 176 and 178 locked in place. The surface of the legs 176 and 178 provide a continuous surface along the side 172 of the end cap 170. In the cross-section shown in FIG. 23, the leg member exemplified by legs 176 of the interconnecting member 174 has a generally U-shaped configuration where each of the arms of the U are represented by the continuing surface or flange 188 and an arm 190 positioned adjacent flange 182 and adapted to engage an inner side wall surface 182 of the end cap 170. It should be noted that this inner side wall surface 182 of the end cap is engaged in sliding relationship by the arm 190 of the leg 176. Further the flange 182 of the leg 176 is located along the inside surfaces 182 between the top and bottom walls of the end cap 153 adjacent or tucked in position at the corner where the top and bottom walls meet.

The interconnecting member 174 co-operating with the slot in the sides 172 of the end cap 153 has the advantage of providing a quick connection between the end cap so that a continuous connection between the end cap and no visual space is seen between the linear lighting fixture which extends along different predetermined axis. Hence the end portions 26 of the linear lighting fixtures 100 and 102 do not abut one another, however the end cap 153 abut adjacent side 172 where the interconnecting member 174 is located. The angle of spread between legs 176 and 178 of interconnecting member 174 is equivalent to the angle a between axis 103 and 103*a*.

It should be understood that the foregoing description with respect to the drawings has been for preferred embodiments of the present invention and that alternate embodiments may be readily apparent to a person skilled in the art.

What is claimed is:

1. A suspension system for suspending adjacent end portions of first and second linear fixtures extending generally along a longitudinal axis from an overhead structure, comprising:

joiner supports mounted to each of the adjacent end portions of the first and second linear fixtures, the joiner support having adjacent first alignment receiving slots extending inwardly from the end portions, and at least one pair of adjacent clamping surfaces accessible from each of the end portions;

a hanger member suspended by a wire from the overhead structure for supporting the first and second linear fixtures from the overhead structure, the hanger member comprising:

a bridge member connected to said wire;

an elongated alignment member supported by the bridge member and having a pair of opposing tongue insert portions, each of the tongue insert portions extending along a corresponding one of the adjacent alignment receiving slots of the joiner supports to loosely juxtaposition the end portions of the first and second linear fixtures with the hanger member;

at least one clamping member supported from the bridge member for relative vertical movement therewith, and the clamping member having two spaced apart wings each adapted to be inserted loosely adjacent a corresponding one of the pair of adjacent clamping surfaces when the tongue insert portions are inserted into the alignment receiving slots and the clamping member being moved vertically to bring the wing members into clamping engagement with the clamping surfaces and move the end portions of the linear fixtures towards each other into locking engagement.

2. The suspension system of claim 1 wherein the elongate alignment member extends transversely across the bridge member and has an opening therein through which the wire passes, and the elongate alignment member is positioned to bisect the bridge member, and the joiner supports further comprising two pairs of adjacent clamping surfaces and two clamping members supported by the bridge member on opposing sides of the elongate support member.

3. The suspension system of claim 1 wherein at least one of the elongate alignment member and the first alignment receiving slot has a locking member adapted to engage the other of the elongate alignment member and the first alignment receiving slot.

4. The suspension system of claim 3 where the locking member is resilient and comprises a hook shaped member on an end portion of the elongate alignment member and the first alignment receiving slot has a depending finger adapted to have its tip engage the hook shaped member.

5. The suspension system of claim 1 wherein each of the joiner supports has at least one socket and an electrical power plug connector seated in the socket, the electrical power plug connector having a plug end facing outwardly of the linear fixture for connection with a corresponding plug connector in an adjacent joiner support, said plug connector and corresponding plug connector mating during vertical movement of the clamping member.

6. The suspension system of claim 3 wherein the elongate alignment member has a width less than that of the first alignment receiving slot permitting lateral displacement of the fixture relative to the hanger member.

7. A suspension system for suspending adjacent end portions of first and second linear fixtures extending generally along a longitudinal axis from an overhead structure, comprising:

joiner supports mounted to each of the adjacent end portions of the first and second linear fixtures, the joiner support having adjacent first alignment receiving slots extending inwardly from the end portions and parallel to the longitudinal axis, and at least one pair of adjacent inclined clamping walls accessible from a respective end portion sloping upwardly of the longitudinal axis and inwardly of the respective end portion;

a hanger member suspended by a wire from the overhead structure for supporting the first and second linear fixtures from the overhead structure, the hanger member comprising:

a bridge member adapted to extend transversely of the longitudinal axis of the linear fixtures and having an opening therethrough,

a washer supported on an undersurface of the bridge member, said washer being connected to said wire passing through the opening;

an elongated alignment member supported by the bridge member and extending transversely of the bridge member to present a pair of opposing tongue insert portions, each of the tongue insert portions extending along a corresponding one of the adjacent alignment receiving slots of the joiner supports in loose locking engagement therewith to loosely juxtaposition the end portions of the first and second linear fixtures relative to each other with limited longitudinal and lateral movement relative to the hanger member;

at least one generally V-shaped wing member having two spaced apart wings and a central interconnecting member, each of the wings generally extending parallel to one of the tongue insert portions and adapted to be loosely inserted adjacent a corresponding one of the pair of adjacent clamp walls when the tongue insert portions are inserted into the alignment receiving slots; and,

a vertically adjustment screw passing through the bridge member and the central interconnecting member of the V-shaped wing member to adjustably support the wing member from the bridge member; and the adjustment screw being adjusted to vertically raise the central portions and wings such that the wings clamp against the clamp walls and move the end portions of the linear fixtures towards each other to lock the joiner supports to the hanger member.

8. The suspension system of claim 7 wherein the elongate alignment member has an opening therein through which the wire passes and the elongate alignment member is positioned to bisect the bridge member, and further two comprising two generally V-shaped wing members supported by the bridge member on opposing sides of the elongate support member.

9. The suspension system of claim 7 wherein the bridge member has two ribs extending outwardly thereof to engage sides of the central interconnecting member of the wing member to prevent the wing member from rotating with the vertical adjustment screw during adjustment of the screw.

10. The suspension system of claim 7 wherein at least one of the elongate alignment member and the first alignment receiving slot has a locking member adapted to engage the other of the elongate alignment member and the first alignment receiving slot.

11. The suspension system of claim 8 where the locking member is resilient and comprises a hook shaped member on an end portion of the elongate alignment member and the first alignment receiving slot has a depending finger adapted to have its tip engage the hook shaped member.

12. The suspension system of claim 7 wherein each of the joiner supports has at least one socket and an electrical power plug connector seated in the socket, the electrical power plug connector having a plug end facing outwardly of the linear fixture for connection with a corresponding plug connector in an adjacent joiner support, said plug connector and corresponding plug connector mating during vertical movement of the clamping member.

13. The suspension system of claim 7 wherein the elongate alignment member has a width less than that of the first alignment receiving slot permitting lateral displacement of the fixture relative to the hanger member.

14. A suspension system for suspending a first end portion of a linear fixture having a longitudinal axis from an overhead structure, comprising:

a joiner support mounted to the first end portion, the joiner support having a first alignment receiving slot extending inwardly from the first end portion, and at least one first clamping surface accessible from the first end portion;

an end cap for capping the first end portion of the linear fixture, the end cap having an open end portion having a second alignment receiving slot extending inwardly of the open end portion, and adjacent the first alignment receiving slot, and at least one second clamping surface accessible from the open end portion adjacent the first clamping surface;

a hanger member suspended by a wire from the overhead structure for supporting the linear fixture and the end cap from the overhead structure, the hanger member comprising:

a bridge member connected to said wire;

an elongated alignment member supported by the bridge member and having a pair of opposing tongue insert portions, each of the tongue insert portions extending along a corresponding one of the first and second alignment receiving slots of the joiner support and end cap to loosely juxtaposition the first end portion of the linear fixture with the open end portion of the end cap and the hanger member; and,

at least one clamping member supported from the bridge member for relative vertical movement therewith, and the clamping member having two spaced apart wings each adapted to be inserted loosely adjacent a corresponding one of the first and second clamping surfaces when the tongue insert portions are inserted into the alignment first and second receiving slots and the clamping member being moved vertically to bring the wing members into clamping engagement with the first and second clamping surfaces and move the first end portion of the linear fixture and the open end portion of the end cap into locking engagement with the hanger member.

15. The suspension system of claim 14 wherein the elongate alignment member extends transversely across the bridge member and has an opening therein through which the wire passes, and the elongate alignment member is positioned to bisect the bridge member, and the joiner

support further comprising two first clamping surfaces, the end cap having two second clamping surfaces, and two clamping members supported by the bridge member on opposing sides of the elongate support member.

16. The suspension system of claim **14** wherein at least one of the elongate alignment member, and the first and second alignment receiving slots, has a locking member adapted to engage the other of the elongate alignment member, and the first and second alignment receiving slots.

17. The suspension system of claim **16** wherein the locking member is resilient and comprises a hook shaped member on an end portion of the elongate alignment member and the first and second alignment receiving slots each has a depending finger adapted to have its tip engage the hook shaped member.

18. The suspension system of claim **14** wherein each of the joiner support and end cap each has at least one socket and an electrical power plug connector seated in the socket, the electrical power plug connector of the linear fixture having a plug end facing outwardly of the linear fixture for mating connection with a corresponding plug connector in the end cap during vertical movement of the clamping member.

19. The suspension system of claim **14** wherein the elongate alignment member has a width less than that of the first alignment receiving slot permitting lateral displacement of the fixture relative to the hanger member.

20. A suspension system for suspending a first end portion of a linear fixture having a longitudinal axis from an overhead structure, comprising:

a joiner support mounted to the first end portion, the joiner support having a first alignment receiving slot extending inwardly from the first end portion and parallel to the longitudinal axis, and at least one inclined ramp clamping wall accessible from the first end portion sloping upwardly of the longitudinal axis and inwardly of the first end portion;

an end cap for capping the first end portion of the linear fixture, the end cap having open end portion and a cap joiner support mounted thereto, the cap joiner support having a second alignment receiving slot extending inwardly of the open end portion, parallel to the longitudinal axis and adjacent the first alignment receiving slot, and at least one second inclined ramp clamping wall accessible from the open end portion adjacent the first clamping surface sloping upwardly of the longitudinal axis and inwardly of the open end portion;

a hanger member suspended by a wire from the overhead structure for supporting the linear fixture and the end cap from the overhead structure, the hanger member comprising:

a bridge member adapted to extend transversely of the longitudinal axis of the linear fixture and having an opening therethrough,

a washer supported on an undersurface of the bridge member, said washer being connected to said wire passing through the opening;

an elongated alignment member supported by the bridge member and extending transversely of the bridge member to present a pair of opposing tongue insert portions, each of the tongue insert portions extending along a corresponding one of the first and second alignment receiving slots of the joiner supports in loose locking engagement therewith to loosely juxtaposition the first end portion of the linear relative to the open end portion of the end cap with limited longitudinal and lateral movement relative to the hanger member;

at least one generally V-shaped wing member having two spaced apart wings and a central interconnecting member, each of the wings extending parallel to one of the tongue insert portions and adapted to be inserted loosely adjacent a corresponding one of the first and second ramp clamp walls when the tongue insert portions are inserted into the first and second alignment receiving slots; and,

a vertically adjustment screw passing through the bridge member and the central interconnecting member of the V-shaped wing member to adjustably support the wing member from the bridge member; and the adjustment screw being adjusted to vertically raise the central portions and wings such that the wings clamp against the first and second ramp clamping walls and move the first end portion of the linear fixture and closed end portion of end cap towards each other locking the end cap and linear fixture to the hanger member.

21. The suspension system of claim **20** wherein the elongate alignment member has an opening therein through which the wire passes and the elongate alignment member is positioned to bisect the bridge member, and further comprising two first and two second clamp walls, and two generally V-shaped wing members supported by the bridge member on opposing sides of the elongate support member.

22. The suspension system of claim **21** wherein the bridge member has two ribs extending outwardly thereof to engage sides of the central interconnecting member of the wing member to prevent the wing member from rotating with the vertical adjustment screw during adjustment of the screw.

23. The suspension system of claim **20** wherein at least one of the elongate alignment member, and the first and second alignment receiving slots, has a locking member adapted to engage the other of the elongate alignment member and the first and second alignment receiving slots.

24. The suspension system of claim **23** where the locking member is resilient and comprises a hook shaped member on an end portion of the elongate alignment member and the first and second alignment receiving slot has a depending finger adapted to have its tip engage the hook shaped member.

25. The suspension system of claim **20** wherein the cap joiner support has a pair of arms with hooks that snap fit into corresponding abutments in the end cap.

26. The suspension system of claim **20** wherein each of the joiner support and end cap each has at least one socket and an electrical power plug connector seated in the socket, the electrical power plug connector of the linear fixture having a plug end facing outwardly of the linear fixture for mating connection with a corresponding plug connector in the end cap during vertical movement of the clamping member.

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